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**Multipurpose Arcade Combat Simulator
(MACS) Basic Rifle Marksmanship
(BRM) Program**

October 1989

**Fort Benning Field Unit
Training Research Laboratory**

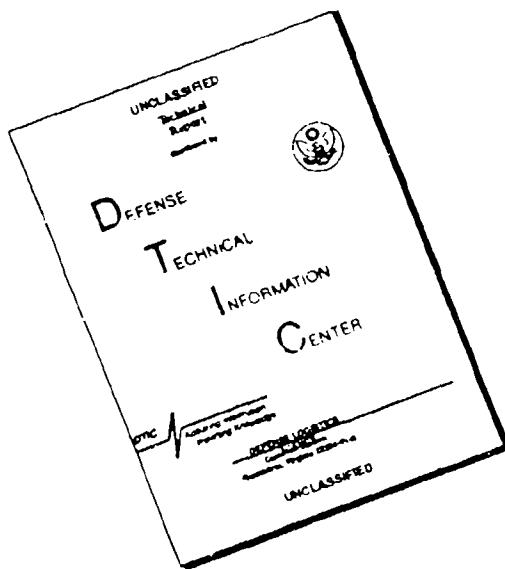
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**Multipurpose Arcade Combat Simulator (MACS)
Basic Rifle Marksmanship (BRM) Program**

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Education and Training

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FOREWORD

The Multipurpose Arcade Combat Simulator (MACS) is an inexpensive, part-task weapons trainer that was developed to overcome the training problems encountered because of insufficient facilities and too few instructors. Because it uses mostly off-the-shelf components, MACS is substantially lower in cost than other available training devices, although it is equally effective. While current interest is focused primarily on its use as a rifle marksmanship trainer, MACS was designed so that the basic hardware could be used to provide training on a variety of weapon systems.

This report describes the Basic Rifle Marksmanship (BRM) software designed for use with the MACS system. An overview of the software is presented, followed by a discussion of the instructional design of the program. Presented in detail are discussions of the feedback provided on marksmanship fundamentals, derivation of performance standards, skill tests used to determine appropriate starting levels, and program options that may be accessed through the menu.

Patented in 1986, MACS is a product of the U.S. Army Research Institute for the Behavioral and Social Sciences Fort Benning Field Unit, which conducts research on training and training technology with particular emphasis on individual and small team skills in the Infantry arena. The research task that supports this mission is titled "Developing Training for Individual and Crew-served Weapons" and is organized under the "Training for Combat Effectiveness" program area. The U.S. Army Infantry School under a Memorandum of Understanding (9 December 1987) and the U.S. Army Training Support Center under a Training Device Need Statement for MACS approved in 1984 provided sponsorship for the MACS research program. The MACS system software described in this report is being fielded Army-wide by the Training Support Center at Fort Benning, Georgia.



EDGAR M. JOHNSON
Technical Director

MULTIPURPOSE ARCADE COMBAT SIMULATOR (MACS) BASIC RIFLE MARKSMANSHIP (BRM)
PROGRAM

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MULTIPURPOSE ARCADE COMBAT SIMULATOR (MACS)
BASIC RIFLE MARKSMANSHIP (BRM) PROGRAM

Introduction

The MACS BRM program has been under development since 1985. The BRM program is intended for school instruction in basic rifle marksmanship, as well as for remedial and sustainment training. The program has been used with particular success in helping the average and below average shooter attain proficiency in marksmanship skills (Evans, 1988). The purpose of this paper is to describe the latest version of the BRM program (Version 8901). The program's instructional design, performance measures, and rationale behind the standards are described in detail. This paper will be of interest to individuals engaged in MACS developmental work and others who are involved in demonstrating the BRM program.

The MACS system is a low-cost, computer-based, part-task weapons trainer. The system components include a weapon (e.g., a demilitarized M16 rifle) with an optical focus light pen attached to the barrel, a Commodore 64 computer, and software appropriate to the characteristics of the weapon. The system allows shooters to practice basic skills by firing at targets at scaled ranges that are displayed on a computer screen. Diagnostic feedback is provided. The program has been validated as a teaching device (Evans, 1988).

The MACS BRM program presents stationary targets only, set at ranges between 50 and 300 meters. The program includes an initial assessment of the shooter's marksmanship skill level, followed by nine progressively more difficult levels of training. Specific performance standards are set for each level. At the end of each level, the shooter's performance is compared to standards within the program. At this point, a shooter may advance to the next level, stay at the same level, or regress to a lower level.

The program is designed to be used with an instructor present; however, one instructor can monitor several systems concurrently, since the on-screen text is largely self-explanatory to the user. As long as a soldier is making satisfactory progress, the computer screen border remains black in color. The instructor's attention is drawn to any soldier having difficulty by a change in border color. The program is designed to help the instructor diagnose the shooter's problems and provide corrective guidance to the soldier. Diagnostic measures include steady position, aiming, trigger squeeze, and breath control. Shot groups for each range are displayed at the end of each firing sequence or level in the program.

The program begins with a marksmanship skill test, which is used to zero the system electronically, and to determine the appropriate starting level for the shooter. Shooters beginning at a low level receive heavily augmented feedback and, as progress is made from level to level, this feedback is gradually withdrawn. When shooters reach Level 7, they are performing with feedback that simulates that found in actual record fire tests and they are firing to record fire standards. Levels 8 and 9 take the shooters beyond basic record fire requirements and prepare them for the Advanced Rifle Marksmanship (ARM) course.

The BRM program is written in 6510 Assembler and BASIC. Flow charts, program documentation, and program listings are presented in Appendixes C through G.

Instructional Design of the BRM Program

When novices learn to shoot, they frequently flinch or blink as they pull the trigger. When flinching occurs in anticipation of the discharge of the weapon rather than following the discharge, it disturbs the lay of the weapon. Thus, in live fire, a new shooter has to learn to control any tendency to flinch and, concurrently, master the fundamentals of marksmanship that enable accurate shooting.

Because the rifle used with the MACS BRM system has no flash, recoil, or cartridge ejection when fired, no anticipatory flinch is induced. This enables the shooter to concentrate on developing the psychomotor skills needed to master the fundamentals of marksmanship. These are maintenance of a steady position, controlled breathing, correct aiming, and good trigger control (Osborne & Smith, 1985; U.S. Army Infantry School (USAIS), 1984).

Evans (1989) has demonstrated that rifle marksmanship simulators that have no recoil train as effectively as those that incorporate it; and he has pointed out that the lack of recoil is of particular advantage to the instructor because it enables errors arising from poor trigger squeeze to be identified. In live fire, such errors are often confounded with errors arising from anticipatory flinch. Poor trigger control has been shown to cause more target misses than does failure to master each of the other fundamentals (Osborne & Smith, 1985; USAIS, 1984).

The Army teaches soldiers to aim at the center of mass of a target. The rationale for this is that if soldiers always aim at the center of mass of a stationary target, they have a higher chance of hitting that target. However, the overall purpose of basic rifle marksmanship training is to enable the soldier to hit the enemy in combat. For this reason, the minimum standard set in record fire is to hit 23 out of 40 targets; the hits are credited irrespective of the location of the shots relative to center of mass. Thus, two separate criteria exist (aim center of mass and hit the target), and these criteria are not always compatible.

For example, a shot that strikes an E-type silhouette in the head is located farther from the center of mass of that target than a shot that just misses the target but is in the horizontal plane of the center of the target. By the criterion of aim center of mass the miss is a better located shot than is the head shot. However, by the hit or miss criteria, the head shot is clearly better. The MACS BRM program uses both criteria. Progress within a level is governed by a requirement to hit a set number of targets, either at each range or in total. Progress from level to level is determined by the accuracy of shots relative to the center of mass of the targets. Therefore, a soldier who progresses through the levels is not only hitting an adequate number of targets, but is hitting targets within reasonable proximity to center of mass.

Many scholars, and notably Smith and Smith (1966), argue that, in essence, the act of learning is the adjustment of one's activities in the

light of feedback received. Thus in learning to shoot, one fires, observes the result (target does or does not fall), makes adjustments, and fires again; the objects being to reduce discrepancies between the goal (hitting the target) and the result (bullet strike - if this is observed). Although a shooter can learn independently, the learning process is speeded by the provision of extrinsic, augmented feedback, such as sure knowledge of where the missing shot went, and guidance on what one did wrong. Bilodeau and Bilodeau (1958) have shown that for some motor skill tasks, the rate of learning is proportional to the number of trials providing extrinsic feedback, and that ten trials each with extrinsic feedback can teach as rapidly as 100 trials with feedback after every tenth trial.¹

Bilodeau (1966) describes three types of augmented feedback that have been demonstrated to help in such tasks; these are concurrent feedback, information feedback, and learning feedback. The MACS BRM program uses all three. Concurrent feedback is artificial augmentation of the effect of a response. In the initial levels of the BRM program (Levels 1 and 2), this is provided by a cross showing bullet strike and the words HIT or MISS appearing on the screen. Information feedback is feedback given immediately after a trial and is an objective assessment of performance. In the initial levels of the program, such feedback is given after every shot and takes the form of a screen showing ratings of the shooter's performance on the four fundamentals of marksmanship (steady position, aiming, trigger squeeze and breath control), as well as a replay of the front sight post coming onto target. Learning feedback is delayed feedback provided at the end of a series of trials. The MACS BRM program provides summary screens showing overall performance at the end of each level.

Because augmented feedback is not available in actual combat, it is important that the shooter does not become dependent upon it. For example, the showing of bullet strike on the screen when the shooters miss aids in adjusting their subsequent shots, but in combat they may not know where the round impacted. Therefore, as the shooter progresses, feedback is gradually withdrawn so that in Levels 3 and 4, detailed single-shot feedback is only given for a poor shot and in Levels 5 and 6, feedback is given only in summary form. By the time shooters reach Level 7, they have learned to operate with the same amount of feedback that they would receive on a record fire range. Precise details of the feedback at each level are in Appendix A and are discussed in the descriptions of the levels (see p. 5). The withdrawal of feedback gradually) and only after the shooter has manifested a reasonable level of proficiency agrees with conclusions reached by Stammers and Patrick (1975) in their comprehensive discussion of the subject.

The MACS BRM program is a self-paced training system that enables individual shooters to progress at a rate appropriate to their initial skill

¹Lavery (1962) argues that performance can contain both variable error and constant error, where variable error is the result of random factors, and constant error is the result of the trainee's behavior. He points out that provision of feedback after every trial can cause a trainee to try and correct for "variable error" and therefore concludes that feedback should only be given at the end of a block of trials. This view is not subscribed to in the design of the MACS BRM program.

levels and aptitudes for the task. When new shooters begin on the system, they are given a test that assesses the level at which they should begin. The program then may start them at any level between 1 and 5. It is only a very competent shooter, however, who begins at Level 3 or above. This test is discussed in detail subsequently.

The program is designed to enable self-pacing. To this end, information screens at the start of each level inform the shooter of the number of targets that will appear, whether they are timed or untimed targets, the position the shooter should adopt (supported or unsupported), and the standard the shooter must meet (e.g., in Levels 1 and 2, to hit two out of three targets at each range). At the start of Levels 1 and 2 only, additional screens instruct the shooter to aim at center of mass and teach what is meant by center of mass. When shooters fail to meet the standard, they are told on screen that they must refire; they are informed when they have refired successfully. Similarly, if they are sent back a level or made to repeat a level, they are told on screen that this is happening, and why it is happening.

Before a novice can use the MACS BRM program to develop marksmanship skills, three basic concepts must be understood. These are correct sight alignment, correct placement of the front sight post on the target, and what is meant by a tight shot group. However, because not all users are novices, these concepts are taught in an optional introductory program that the instructor can access via the system menu. This program is described in the section on optional programs and features.

For the expert marksman, a motivational element is present in the program. At the end of level 9, the top ten shooters may record their initials on the screen upon completion of the level. The recording of shooter's initials is designed primarily to encourage competition among those undergoing sustainment training.

The MACS BRM program is designed so that one instructor can monitor a number of shooters, firing on separate individual systems, simultaneously. This is achieved by making the program as self-explanatory as possible. As long as a shooter is making steady progress, the screen border remains black. Only when a shooter is having difficulty does the border change color. Therefore, instructors can scan rapidly down a row of monitors and determine where their individual attention would be best applied. The border color coding is as follows:

- A black border indicates that the shooter is making satisfactory progress.
- A red border indicates that the shooter is refiring targets at a particular range, or a part of a level.
- A blue border shows that the shooter has been made to repeat a level.
- A yellow border means that the shooter has been sent back a level.
- A purple border indicates either that the shooter is aiming off screen and pulling the trigger, or that the light pen is not reading properly.

When an instructor sees a border color that indicates a shooter is having difficulty, the level the shooter is on, the particular target within the level the shooter has reached, and the number of times the shooter has refired can be checked. This information is given in a small inset in the top left-hand corner of the screen. The on-screen feedback designed for the shooter is, of course, also available to the instructor to help diagnose the problem the shooter is having.

Summary of the BRM Program

A brief discussion of each of the nine levels is provided below. Optional features that may be used with some or all of these levels are described separately, as is the initial skills test. A summary level-by-level description of the program with details of feedback and standards is given in Appendix A. Program features, such as the initial skills test, are described elsewhere.

Levels 1 and 2 are designed to develop basic skills. The only difference between the two levels is that Level 1 is fired in the supported position and Level 2, unsupported. For Levels 1 and 2, detailed shot-by-shot feedback is provided. When the shooter fires at the target, HIT or MISS is indicated on screen and the bullet strike is shown by a cross. The shooter then receives a rating (EXCELLENT, GOOD, AVERAGE, BELOW AVERAGE, POOR) on three diagnostic measures (steady position, aiming, trigger squeeze) for the shot fired, and the location of the shot relative to center of mass of the target is rated. Breath control is rated O. K. or CHECK. The movements of the front sight of the rifle are replayed for a period of up to 6 seconds before trigger closure. Then the frame is briefly frozen to allow comparison of the final front sight position (shown in white) with the correct front sight position of the target (shown in black). Three targets are presented at each of six ranges (50 to 300 m). F-type targets are presented at 50 and 100 m, E-type targets at all other ranges. After each set of three shots, a screen showing the three-round shot group on a single target is provided. At the end of the 18 shots, a summary of the mean ratings for steady position, aiming, trigger squeeze, breath control, and shot location is presented. As shooters go through each level, internal algorithms determine whether they should refire targets at a given range, and at the end whether they should be permitted to advance to the next level.

Levels 3 and 4 introduce shooters to timed targets and to the need to adjust their aims for targets at different ranges. To this end, targets at different ranges are presented in a random order. Concurrently, some of the feedback is withdrawn. HIT and MISS no longer appear on the screen, and diagnostic information and replay are provided only when the shooter fires badly (rated POOR by one of the diagnostic measures or BELOW AVERAGE on shot location). The main difference between the levels is that Level 3 is fired in the supported position and Level 4, unsupported. There is a slight relaxation of standards for 250- and 300-m targets when they are fired at from the unsupported position. Information and replay are provided only when the shooter fires poorly (rated POOR by one of the diagnostic measures or BELOW AVERAGE on shot location).

Levels 5 and 6 provide practice for record fire. The number of targets at each range and their exposure times are the same as those used in record fire, but the order of target presentation is randomized. In Level 5, bullet strike is still shown by a cross for both misses and hits; in Level 6, it is shown for misses only. At these levels, diagnostic feedback and replays are no longer provided. Only two measures are taken, a count of hits and misses, and the measure of shot location. The rationale for this is that good shot location is largely the result of having a steady position, accurate aiming, and good trigger squeeze. These have been emphasized for four levels, and the shooter should by now have an understanding of the causes of poor shots. Levels 5 and 6 are both divided into two parts: the first 20 shots are fired from the supported position and the next 20, unsupported. Shooters must hit 15 out of 20 targets on the first part before proceeding to the second part, which also requires 15 out of 20 hits; thus shooters are being trained to sharpshooter standard (30/40). At the end of each level, shooters are graded according to the number of targets they hit (Expert 36/40, Sharpshooter 30/40, Marksman 23/40, or Unqualified). Because training is to sharpshooter standard, shooters are graded marksman if they have to refire one of the positions.

Whereas the criterion for getting through the two parts of Levels 5 and 6 is the number of hits obtained, the mean rating of shot location determines whether the shooter progresses to the next level, refires the same level, or regresses one level. Thus shooters who have hit the 30 out of 40 targets needed to get through a level may still be regressed one level if the mean rating of shot location, over all 40 targets, is POOR. This is reasonable because an average rating of POOR indicates that they are just nicking the targets rather than hitting them squarely.

Level 7 (record fire) is the culmination of the previous six levels of training and is an on-screen re-creation of actual record fire. It is identical to the previous level (Level 6), but feedback is reduced to that which a shooter would receive on the record fire range, i.e., targets disappear when hit, or remain until their exposure time has elapsed (indicated by a whistle) and then disappear. Bullet strike is no longer shown, and no replays or diagnostic scores are given. Level 8 (rapid record fire) takes the shooter beyond the requirements for record fire. It is identical to level 7 in structure, but the exposure times of targets are reduced to two-thirds of the time allowed for record fire as an initial step in the transition to the engagement of moving targets, in the MACS Advanced Rifle Marksmanship (ARM) program (under development).

Level 9 (combat fire) is an attack/retreat scenario. Because up to five individually timed targets may appear on the screen simultaneously, and because new targets may appear as others are being engaged, it teaches shooters to maintain an awareness of their whole fields of fire even as they engage particular targets. Individual target exposure times vary but are similar to or less than those allowed for record fire. The level is divided into two parts, the first 40 shots being fired from a supported position and the second 40, unsupported. The shooter must hit 23 out of 40 targets on the first part before proceeding to the second part, which also requires 23 out of 40 hits. If shooters do not meet this standard, they must refire the position. At the end of each position, the shooter is graded Expert, Sharpshooter, Marksman, or Unqualified. Once a shooter has reached this level, the only measure taken is hit or miss. The locations of the shots

relative to center of mass of targets are no longer considered, and therefore there is no question of the shooters being sent back a level or being made to repeat the whole level.

BRM Program Feedback

The instructional design of the BRM program incorporates feedback for each shot fired in Levels 1 and 2, and for poor shots in Levels 3 and 4. Ratings are provided for each of the four marksmanship fundamentals: steady position, aiming, breathing, and trigger squeeze. In addition, a rating of shot location is provided. The first four measures are diagnostic, and assess the shooter's performance up to the moment of firing. The shot location measure assesses bullet strike in relation to center of mass.

The diagnostic and resultant scores are obtained as follows. The light pen reads the screen constantly and maintains a running memory (stack) of 127 readings¹. Immediately after trigger closure, the appropriate readings are extracted from the stack and the scores are calculated. These scores are then compared with criteria values to obtain the verbal ratings. The scores for each measure are described below.

The shot location score is determined by the radial distance between the location of the last light pen reading before trigger closure and the center of mass of the target.

The aiming score is determined by the radial distance between the mean point of aim (the average location of readings 45 through 7 (inclusive) before trigger closure) and the center of mass of the target. Because the light pen takes 60 readings per second, the aiming score is taken over a period of 0.65 seconds.

The steady position score is based on the standard deviation of light pen readings in the X and Y axes about the point of aim and is also taken over readings 45 through 7 before trigger closure. The greater the degree of wobble, the greater the standard deviations, and the lower the score awarded.

Since breath control cannot be directly measured, the ratings assigned to breath control are derived from the steady position score. The three highest steady position scores (EXCELLENT, GOOD, or AVERAGE) correspond to a breath control rating of O.K. The assumption is made that given a relatively steady position, breath control is adequate. If the position is relatively unsteady, as indicated by the two lowest steady position scores (BELOW AVERAGE and POOR), the breath control feedback is CHECK. The assumption is made that a poor steady position may be due to poor breath control, or to other factors. Breath control, as one of the four fundamentals of marksmanship, is emphasized in the feedback given to the soldier. Of course, the instructor observing the soldier in the act of shooting, will remain alert for other factors contributing to unsteadiness.

¹This should not be confused with the replay which is based on 256 readings taken with a sampling rate of 20 readings per second.

The trigger squeeze score is based on the range of readings in the X and Y axes about the point of aim, and is taken from reading 6 before trigger closure to reading 3 after trigger closure; that is, over 0.15 seconds. It should be noted that the trigger squeeze measure is not concerned with how rapidly or steadily the trigger is squeezed, but with whether or not the point of aim is disturbed. The actual algorithms used to compute all diagnostic scores are in Appendix H.

Aiming and Shot Location

The MACS BRM program contains separate standards for firing in the supported and unsupported positions; those for the supported position are more rigorous. A supported position is a "position which utilizes something other than the body to steady the weapon" (USAIS, 1984). The unsupported position assumes no support other than the body and the ground. The difference is that in the unsupported position the weight of the rifle is borne by the forearm, wrist, and hand, whereas in the supported position some object bears this weight. Thus shooters in a standing foxhole position, who use the ground to support their elbows, are defined as firing unsupported. If the rifle is bedded onto sandbags, then firing is termed supported.

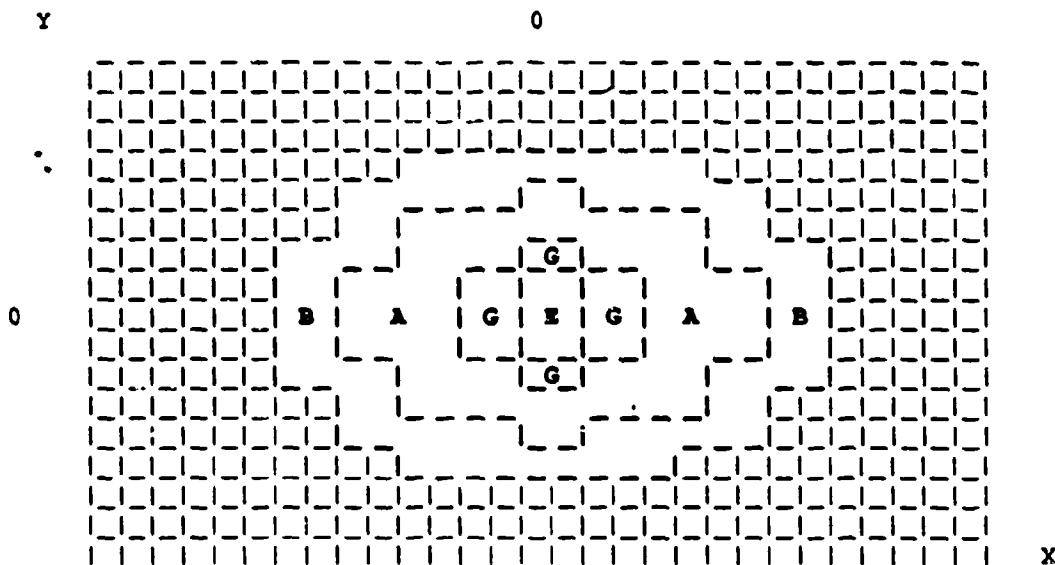
Supported position. Underlying all targets that appear on the screen is a second, unseen, and mathematically defined target area that is analogous to a bull's-eye. The rings of this bull's-eye are defined in terms of radial distances (in pixels) from the center of mass of each target, with a correction to accommodate the rectangular shape of pixels (so that the unseen bull's-eye is close to circular on the screen), and adjusted to ensure that the areas defined as EXCELLENT and GOOD correspond closely to 2-cm and 4-cm circles on an E-type silhouette target scaled for 25 m.

This bull's-eye is of constant size, irrespective of the perceived size of targets. Figure 1 shows a representation of the unseen bull's-eye on a section of screen. The small rectangles represent the pixels on the screen. The mathematically defined midpoint of the target area is shown as point 0,0. As can be seen, the target area is not centered perfectly on the midpoint, and even with a redesign of the shape of the area it could not be perfectly centered. This is because of the way the computer stores the values of odd-numbered pixels in the X axis, and is fully explained in Appendix B.

The midpoint of the mathematically defined target area is always set at the center of mass of each target seen on the screen. When a shot is fired at the target, and if the mean point is computed to be in the area designated GOOD, then the shooter receives a rating of GOOD for aiming. If the final light pen reading before trigger closure is from one of the six pixels labeled EXCELLENT, then shot location is rated as EXCELLENT. The mathematically defined target area is smaller than the 50- and 100-m targets, but larger than those at 150-m and beyond. For example, the 300-m target is only 5 pixels wide and 9 pixels high. Therefore, a shot can miss a 300-m target and still hit the underlying target area in the area rated as average. Because it is not intuitively obvious to the user how a miss can deserve a rating of AVERAGE in shot location, the shot location score is reported on the screen as a MISS. On-screen ratings of POOR through EXCELLENT are given only when the target has been hit. However, the computer maintains an internal record of the actual

rating, and this is included in the calculations for the summary feedback screens.

Target Area (Supported Position)



Key. E = Excellent G = Good A = Average B = Below Average
Shots located outside the indicated areas are rated POOR

Figure 1. A representation of a 2.15×1.66 cm section of screen, showing the target area and the ratings that are awarded for mean points of aim and shots located at different distances from the center of mass. The point 0,0 would be at the center of mass of an observed target.¹

The areas defined in the underlying bull's-eye target are best explained by relating them to circles on a target at 25 m. The area defined as EXCELLENT comprises 6 pixels. These 6 pixels occupy the same area as would a circle of 0.24 cm diameter on the screen. A circle of .24 cm diameter subtends an angle of 2.68 minutes of arc when viewed at 3 m, which is the eye to screen distance for using the MACS system. Viewed at 25 m, a circle of 1.95-cm diameter would also subtend an angle 2.68 minutes of arc. Thus were a shooter's shot location to be rated EXCELLENT on three consecutive shots, he could have fired the equivalent of a 2-cm, three-round shot group at 25 m. In a similar manner, we can calculate that the area defined as GOOD or better, equates to a circle of 3.73 cm diameter at 25 m, AVERAGE to a circle of 7.30 cm diameter, BELOW AVERAGE to a circle of 10.25 cm diameter, and POOR is greater than 10.25 cm.

¹Actual pixels are longer in the Y axis than in the X axis (approximate ratio is 1.33:1); the on-screen target area is, therefore, more circular in shape than is shown.

The target areas were derived from two sources. First, 300 initial entry trainees fired a series of 250-m targets on MACS. The distances between bullet strike and the center of mass of the targets were recorded in numeric form and the mean and standard deviation (SD) of the numeric scores were calculated (Hunt et al., 1987). Arbitrarily, shots located within 1 SD either side of the mean were termed AVERAGE, shots located between 1 and 2 SDs above the mean were termed GOOD, and those over 2 SDs above the mean were termed EXCELLENT. Likewise, shots located between 1 and 2 SDs below the mean were termed BELOW AVERAGE, and those over 2 SDs below the mean were termed POOR. This yielded an underlying bull's-eye target that reflected the performance of novice shooters but was overgenerous as a training standard. The area rated GOOD or better, for example, equated to a circle of 4.64 cm diameter at 25 m.

The second source used was Field Manual 23-9 (Department of the Army, 1988), which contains guidelines for categorizing shot groups on a scaled E-type target at 25 m (fired from the supported position). These state that a 2-cm, three-round shot group "indicates no ... shooter error is involved," a 3-cm, three-round shot group represents "acceptable firing performance," a 4-cm, three-round shot group indicates that "shooter error" has occurred, and a 6-cm, three-round shot group indicates obvious error.

Using this information, a constant was added to the algorithms derived from the performance of the 300 trainees that resulted in the target area shown in Figure 1. The areas defined in Figure 1 as EXCELLENT and GOOD are the closest approximation that can be reached on the screen to circles of 2 and 3 cm diameter at 25 m. (For reasons discussed in Appendix B, odd-numbered pixels in the X axis always take the value of the pixel to their left. This means that no part of the area defined as GOOD in Figure 1 can be reduced without that part being eradicated. One cannot, for example, make the areas left and right of EXCELLENT just 1 pixel wide.) Scores of AVERAGE and below for shot location indicate that shooter error has occurred. The choice of the term AVERAGE to describe inadequate shooting was made with a view to encouraging the shooter. We may also note that the shooter who is rated average on shot location has in fact fired a little better than what was defined as average from the performance of the trainees. This is because the constant that was added to limit the area defined as GOOD, also reduced the areas designated AVERAGE and BELOW AVERAGE, in each case by approximately 40%.

It has been inferred that if shooters could consistently score EXCELLENT on shot location with MACS, they would be placing their shots within the equivalent of a 2-cm circle at 25 m. In fact, such consistency would exceed the technical limits of the system. This is because the light pen is not that precise. A light pen is judged to be correctly calibrated if it reads to within 2 pixels (+ or -) of a given pixel. In fact, a well grounded and correctly calibrated light pen does a little better than this, in that it rarely deviates more than 1 pixel in the Y axis. Because of these deviations, a shooter who consistently fires at the precise center of mass of a target will occasionally have his shot location rated as GOOD; similarly, GOOD shots will on occasions be rated EXCELLENT. Over an entire level of shooting, these deviations cancel out, so that summary screens are more accurate than are feedback screens on individual shots.

Unsupported position. The criteria for allocating ratings of shot location and aiming in unsupported fire are less rigorous than those for

supported fire. This is because firing from an unsupported position is more difficult than firing supported. The target areas are shown in Figure 2.

As may be seen, the area rated as EXCELLENT now comprises 10 pixels on the screen. Scaled out to 25 m, this may be equated to the area encompassed by a circle of 2.52 cm diameter. The area rated as GOOD or better has been increased to 42 pixels and equates to a circle of 5.16 cm diameter at 25 m. One implication of the larger target areas is that deviations in light pen readings have a reduced impact. Therefore, a shooter who consistently aims and fires at the exact center of mass of a target should receive single shot ratings of EXCELLENT with far greater reliability than occurs in the supported position. As with the supported position, the criteria were originally developed from the measured performance of the 300 trainees. These criteria were then modified by the introduction of the same constant that was used to reduce target areas in the supported position; thus the changes made are proportional to those made for the supported position.

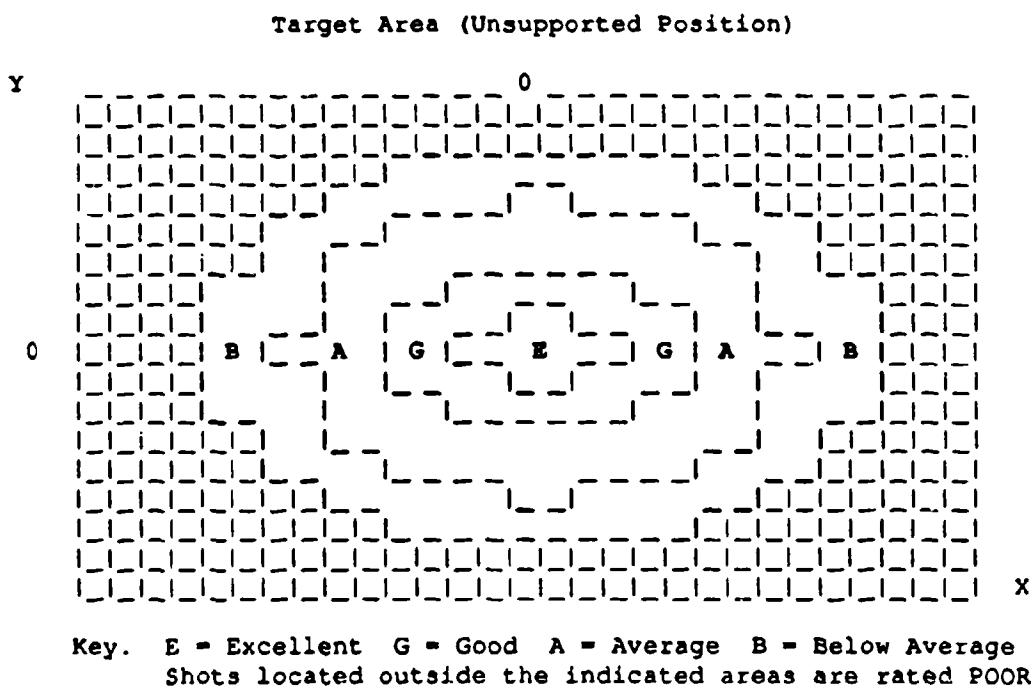


Figure 2. A representation of a 2.15×1.66 cm section of screen, showing the target areas and ratings awarded for mean points of aim and shots located at different distances from the center of mass for unsupported fire.'

'Actual pixels are longer in the Y axis than in the X axis (approximate ratio is 1.33:1); therefore on-screen target area is more circular in shape than is shown.'

Steady Position and Trigger Squeeze

Steady position ratings for each shot are made based on the sum of the standard deviations of light pen readings in the X and Y axes (corrected for pixel shape), for readings 45 through 7 before trigger closure. The sum is then compared with criteria values. The criteria values were originally established using data collected from the group of 300 trainees referred to earlier. Subsequently, the correction factor for pixel shape was added, and this had the effect of inflating the Y-axis standard deviations. Therefore, the degree of dispersion (wobble) permitted for a shooter to earn a given rating is reduced. These tightened standards agree with the recommendations of subject matter experts (SMEs). The criteria used are given in Table 1.

Table 1.

Criteria Values of Standard Deviation (SD) and Range (R) for Ratings of Steady Position (SP) and Trigger Squeeze (TQ)

	Ratings				
	<u>Excellent</u>	<u>Good</u>	<u>Average</u>	<u>Below Average</u>	<u>Poor</u>
Supported Position					
SP	0<SD<=2.5	2.5<SD<=5.0	5.0<SD<=8.0	8.0<SD<=10.5	10.5<SD
TQ	0< R<=2.5	2.5< R<=5.0	5.0< R<=8.0	8.0< R<=10.5	10.5< R
Unsupported Position					
SP	0<SD<=4.0	4.0<SD<=6.5	6.5<SD<= 9.5	9.5<SD<=12.0	12.0<SD
TQ	0< R<=4.0	4.0< R<=7.0	6.5< R<=11.0	9.5< R<=14.5	14.5< R

Trigger squeeze is measured over the 9/60 of a second period about the moment of firing. The readings used are from the sixth reading before to the third after trigger closure. Measurement is by taking the range of light pen readings in the X axis and in the Y axis (with the Y values corrected for pixel shape), adding the two ranges together, and comparing the resulting score with the criteria values (see Table 1). The mathematical procedures used to compute the steady position and trigger squeeze measures were adopted because of the need to minimize computer processing time. The more obvious method of computing the standard deviation and range from the radial distances between individual light pen readings and the mean point of aim was found to cause unacceptable delays in providing feedback.

In the supported position, the decision to use the same criteria for trigger squeeze as are used for steady position means that a shooter who is rated GOOD on steady position must hold the weapon even more steadily at the moment of trigger closure if he is also to obtain a GOOD on trigger squeeze. This is because the whole range of movement in the 9/60 of a second period about trigger closure must be equal to or less than the standard deviation of

movement in the preceding 36/60 of a second. These more rigorous demands mean that soldiers who wish to improve their trigger squeeze are forced to concentrate on maintaining the lay of the weapon as they pull the trigger.

In the unsupported position, the criteria for trigger squeeze and steady position diverge, the differences between them increasing with the descending order of ratings. This is done to make some allowance for the poorer novice shooter whose fundamental problem may be lack of strength or sufficient muscle tone to bear the weight of the rifle for extended periods, so that muscle fatigue induces tremor.

It should be emphasized here that MACS is a teaching device, designed to facilitate the development of the psychomotor skills necessary to fire the weapon accurately. It is not an analytic tool designed to measure precisely the degree to which shifts in the lay of the weapon are directly attributable to poor trigger control. In fact, although the range of movement that is measured at trigger squeeze may often be the result of poor trigger control, it may equally be nothing more than the range of movement that was present when steady position was measured. In other words, a poor trigger squeeze score can result from an unsteady position. This being acknowledged, let us also recognize that a soldier who concentrates on carefully squeezing the trigger while maintaining the point of aim, is learning to hold the weapon steadily, which is the object of the exercise.

The method of measuring trigger squeeze, and the criteria used to award ratings, were derived empirically. Earlier versions of the BRM program took the standard deviation of the movement, but SMEs judged this measure to be too insensitive. To increase the sensitivity, the range was substituted for the standard deviation. It was then found that the criteria originally derived from the performance of the IETs were too rigorous (SMEs could detect no differences in their own trigger squeeze between shots even though the ratings suggested great differences had existed). Thus, by trial and error, it was found that the steady position criteria combined with the range score gave a degree of sensitivity that was judged appropriate by SMEs.

A detailed explanation of the derivation of the steady position and aiming ratings may be found in Evans' (1988) review. The breath control rating is derived from the steady position measure. Steady position ratings from average to excellent correspond to a breath control rating of O.K., and the below average and poor ratings correspond to a breath control rating of CHECK.

BRM Program Standards

Progression through a level is determined by a simple count of the number of targets hit. A standard is set for each level, and an information screen at the start of the level tells the shooter what the standard is. The standards for each level are given in Appendix A. The instructional principle underlying this progression is that of overlearning. "Overlearning is additional practice after performance standards have been met," and its value is that it aids retention and "tends to prevent skill deterioration under stressful conditions, such as combat" (Bryan & Regan, 1972). The performance standard used to pass a soldier on record fire is that of hitting 23 out of 40 targets. The MACS BRM system achieves overlearning by demanding a higher

standard, and making shooters who fail to meet the standard refire until they succeed. Thus in Levels 1 and 2, the standard is to hit 2 targets out of 3 at each range, which equates to 27 hits with 40 shots; failure to meet the standard at a range necessitates an immediate refire of three more targets at that range. In Level 3, the standard is to hit 3 out of 4 targets at each range; this equates to 30 hits with 40 shots, which is sharpshooter standard. In Levels 5 through 8, the standard is to hit 15 out of 20 targets in each firing position (supported and unsupported), which again equates to 30 hits with 40 shots, and failure to meet the standard requires an immediate refire of all 20 targets in that position.

Progression from Level 1 through Level 4 is determined by the mean ratings that the shooter receives at the end of each level, for steady position, aiming, trigger squeeze, and shot location. For Level 5 through Level 9, only shot location is considered.

For Levels 1 to 4, a shooter must achieve a mean rating of AVERAGE or better on all four measures before he is permitted to advance to the next level. A score of BELOW AVERAGE or POOR on any one measure indicates a failure to apply at least one of the fundamentals of marksmanship correctly at that level, and therefore the shooter is made to repeat the level. A mean rating of POOR on two measures will cause the shooter to be sent back one level.

A shooter who has progressed to Level 5 has demonstrated the ability to hold the rifle steady, aim correctly, squeeze the trigger without disturbing the lay of the weapon, and, not merely to hit a sufficient number of targets at each level, but to hit them close to center of mass. He has demonstrated this ability when firing in the supported and unsupported positions, and against timed targets in both positions. Therefore, from Level 5 onward the three individual diagnostic measures are dropped, and progress is determined solely by consideration of shot location. The rationale behind this is that, to achieve an adequate score on shot location, the shooter must be applying the fundamentals of marksmanship, and therefore the individual skills are still implicitly being tested. If, at the end of a level, the mean shot location is BELOW AVERAGE, then the shooter is made to repeat the level. If shot location is POOR, then the shooter is sent back one level.

One implication of these standards is that shooters may hit a sufficient number of targets to get through a level but will only pass the level if they have on average also hit close to their centers of mass. In this sense, the standards demanded for record fire in the MACS BRM program are higher than those demanded in actual record fire, where a hit is sufficient.

BRM Program Skill Tests

When new shooters begin on the MACS BRM program, they are automatically taken into hierarchically structured marksmanship skill tests that assess their abilities and determine appropriate starting levels. The process is described below, and is shown as a flow chart in Appendix C. The flow chart for programming is given in Appendix D.

As a first step in the testing process, the shooter is told to fire three rounds from the supported position to establish an initial shot group. These

first three rounds are of key importance to the system because they are used by the computer to perform an electronic equivalent of zeroing the rifle. The system assumes that shooters are aiming at the center of mass of each target to the best of their abilities. It then computes the central point of the three-round shot group, measures the distance between this central point and the actual center of the target, and uses this distance as a constant offset value, which is applied to all subsequent shots. In effect, it moves the shot group onto target electronically rather than by mechanical adjustment of the sights.

From the shooter's viewpoint, the sequence begins with information that states to aim at the center of mass targets, and illustrates what is meant by center of mass. The shooter fires one shot at each of three scaled 250-m, E-type targets. As soon as the three shots have been fired, a feedback screen is shown that gives ratings of steady position, aiming, and trigger squeeze, an assessment of the quality of the three-round shot group (POOR through EXCELLENT) and a close up of the target showing the three-round shot group. The rating of shot group is computed in the same way as that of shot location. The difference in name arises because, for the first three shots, the radial distance of each individual shot is calculated from the shot group center (which is not yet related to target center because the system is in the process of zeroing). Whereas subsequently, radial distances are directly related to the center of mass of targets, and shot location relative to the target can be reported.

As with actual rifle fire, the tighter the shot group the better the zero. The system is able to compute a usable zero offset from a very poor initial shot group, but a limit is set. For each target, a rectangular area is mathematically defined within which all three shots must hit for the shot group to be accepted. This rectangular area would equate to an area 46 cm wide and 24 cm high on a 25-m target. If the shot group is too large to fit within the rectangle, the shooter is told the shot group is invalid, and is invited to try again. If, on the second try, the group is still invalid, either the shooter is making some gross error (such as looking over the rear sight aperture rather than through it) or the light pen is out of alignment with the bore of the rifle and the system requires adjustment. This latter possibility is indicated on screen to cue the instructor, and a program can be accessed from the menu that will let the instructor test and, if necessary, reset the light pen alignment. This program is described subsequently.

Because the system is designed to teach novices, it will accept a very large shot group as valid (within the limits detailed above) and allow the shooter to proceed. The reason for this is that one cannot expect a novice to shoot a tight shot group until the fundamentals of marksmanship have been learned. MACS is designed to teach these fundamentals, and, to state the obvious, the shooter must be able to get into the system in order to learn. However, because the system is also designed to be used by experienced personnel in sustainment training, the shooter is given the option of refiring the first three shots until a tight three-round shot group is achieved. On MACS, a tight shot group is defined as one that is rated as GOOD and is equivalent to placing the three shots in a 3.7 cm circle at 25 m. Although any valid shot group will zero the system adequately for a novice, the experienced shooter may wish to continue to refire until a tight group is achieved. This is because the three-round shot group that the shooter finally

accepts is the one used to zero the system electronically for all future shots.

The shot group the shooter accepts is used also as an initial determinant of skill. If, for the measures of steady position, aiming, trigger squeeze, and shot group, shooters obtain a minimum of two ratings of EXCELLENT and two ratings of GOOD (irrespective of order), they are judged to be competent in firing at non-timed targets in the supported position. Those who do not meet this standard are routed immediately to Level 1 (Introduction to Supported Position). For shooters who meet the standard, a second three-round test is given, using the same targets but engaged from the unsupported position. The same criteria are applied. Those who do not meet the standard are directly routed to Level 2 (Introduction to Unsupported Fire). Shooters who pass the second test take a third test that comprises three timed targets at different ranges (100, 250, and 300 m), the targets to be engaged from the supported position. Failure to meet the standard on the third test takes a shooter to Level 3 (Timed Targets in the Supported Position). Shooters who meet the standard are given a fourth and final test, which is identical to the third, except that it is fired from the unsupported position. Failure to meet the standard in this test routes the shooter to Level 4 (Timed Targets in the Unsupported Position), and success takes the shooter to Level 5 (Practice Record Fire).

The four tests are hierarchically structured to select the very able shooters. The poor shooter and the novice never know that they have been tested or that the tests exist; they simply establish a shot group and go straight to Level 1. The standards demanded in the tests are deliberately set at a high level, so that only those who have no need of additional training or practice in the fundamentals of marksmanship can move straight to practice record fire. Although the system will automatically direct a shooter to a starting level that the system's internal logic deems appropriate, the instructor can override the system. If the instructor feels that a level is inappropriate, the menu can be accessed, and the shooter moved to a different level.

BRM Program Menu and Options

The program contains a menu that allows a number of additional programs and special features to be called into use. These are described below.

Light Pen Mount Alignment Program

The light pen is mounted to the barrel of the M16 demilitarized rifle by a mounting bracket. This bracket holds the light pen securely and in alignment with the bore of the weapon. Accident or rough handling can disturb the alignment, and therefore a program is provided to allow the instructor to check the alignment and realign if necessary. The alignment program provides an on-screen aiming point and a target area. The point at which the light pen is reading is shown by a black dot on the screen. If the black dot is in the target area when the sights are placed on the aiming point, and if the black dot tracks smoothly across the screen as the weapon is moved, then the light pen is correctly aligned. If the light pen is incorrectly aligned then the mounting screws must be loosened and the light pen position adjusted. The

procedures for this may be found in the Trainer's Guide (Purvis & Wiley, 1989).

Sight Alignment, Aiming, and Grouping Program

The program is designed to teach three basic concepts; these are the correct alignment of the front and rear sights, the correct placement of the front sight post on the target, and the meaning of a tight shot group. Programming flow charts for this program may be found in Appendix E. The program is divided into four parts.

The first part provides a demonstration of the correct alignment of front and rear sights, which is followed by a self-paced test in which a series of sight alignments are shown on the screen and the soldier must determine whether alignment is correct. The soldier responds by pulling the trigger on the MACS rifle when the appropriate response is highlighted on the screen. Feedback is given after each decision. The feedback acknowledges correct responses and, when responses are incorrect, tells the soldier why the answer was wrong. Soldiers must give three consecutive correct answers to move on to the next part of the program.

The second part of the program provides a demonstration of correctly aligned sights moving onto a scaled 250-m, E-type target. The demonstration is supported by on-screen text and is iterative, continuing until the soldier understands and is ready to proceed. The demonstration is followed by a self-paced test, which is structured exactly like that for sight alignment.

The third part is a test, in which a series of randomly generated sight pictures are shown. One in three of these sight pictures is correct; the remainder have poor sight alignment and/or incorrect placement of the front sight post on the target. As with the previous two tests, the soldier indicates correct or incorrect using the trigger as a response button. Feedback is given after each decision, and the shooter must give three consecutive correct answers to complete the test.

Although the primary purpose of the program is to teach concepts, because precision of sight placement is required in marksmanship, fine judgments are demanded of the soldier in the tests. The soldier is required to detect errors in sight placement that range between 1 and 3 pixels in the X axis and 1 and 2 pixels in the Y axis. At 3 m, the height of a pixel (Y axis) subtends an angle at the eye of 1.1 minutes of arc, and the width of a pixel (X axis) subtends 0.84 minutes of arc. Of the two, the Y axis displacement is the more difficult to resolve because, on occasions, the soldier must hold an image of the target in memory when making a judgment. This is because the image of the front sight post may obscure the lower part of the target. In the X axis, the soldier must discern the degree of lateral displacement and can use the sides of the target and the sides of the sight as referents. The 0.84 minutes of arc minimum displacement is well within human capabilities; indeed, Berry, Riggs, & Duncan (1950) have shown that discriminations of lateral displacement (vernier acuity) as small as 6 seconds of arc are possible even with low background luminance levels.

The fourth part of the program is designed to help the novice understand the difference between a tight shot group and a large shot group. It does

this by showing demonstrations of three-round shot groups hitting the image of a 25-m zeroing target. The referent taught is the 4-cm circle in the center of the target. Once the soldier has seen the demonstration, a self-paced test is given in which the soldier is asked to judge whether or not a series of shot groups are tight. Feedback is given after each decision. The feedback either acknowledges a correct response or, in the case of an incorrect response, demonstrates whether the three-round shot group would fit inside the 4-cm circle. The soldier must answer three consecutive questions correctly to complete the program.

The MACS BRM program has a number of optional features that an instructor can elect to use with some levels of the program. These are given on a menu that the instructor can access at the keyboard and are briefly described below.

Wind Speed

The program allows an instructor to set wind speed at 0, 10, or 20 mph, and wind direction relative to the firing range (across the range, oblique to the range, or in line with the range). This option may be selected for any and all levels of fire. To help the instructor teach soldiers the correct sight placement, a teaching screen appears at the start of the shooting sequence, which shows the correct sight placement on targets at 50, 150, and 300 m for the direction and speed of wind selected.

Call Your Shot

This option applies only to Levels 1 and 2. For each shot, it builds in a 5-s time delay (with on-screen counter) before feedback and bullet strike are shown. This allows the shooter time to announce where they believe the bullet strike will be.

Targets at 250 M

This option applies to Level 1 only. It allows the instructor to set all 18 targets to 250 m, so that the shooter can practice at a single range. It is intended for use with novice shooters who are experiencing difficulty at Level 1, and it parallels the ability instructors have in live fire of moving a novice to a 25-m range for practice. The 25-m target is a scaled-down, 250-m target, as is the target on the MACS screen, so that the two equate.

Discussion

The development of the MACS BRM program was evolutionary rather than entirely planned. It began as a diagnostic tool to help instructors determine what a shooter was doing wrong. This early program resembled Level 1 of the present BRM program. Subsequently, the diagnostic program was transformed into a teaching program. The transformation process was gradual, and as a result the system received considerable testing during development. In the process, less advanced versions than that described in this paper were demonstrated to be effective in improving rifle marksmanship (Evans, 1988).

The transformation from diagnostic tool to training device obviously necessitated many changes. For example, a new measure, aiming, was introduced

because aiming is one of the four fundamentals of marksmanship taught by the Army. New levels were added to take the soldier through to record fire standard, and the standards themselves were tightened so that they paralleled those demanded of soldiers on actual ranges. Because these changes happened sequentially rather than as a planned single modification, the reader may have formulated some questions on developmental methodology. For example, it is reasonable to ask why, given the new training role, the criteria for rating performance are still based on a modified version of trainees performance, and why no new data from trained soldiers have been collected. The answer is twofold. First, time constraints did not permit additional experimentation. Second, and from a purely practical viewpoint, the present system works, and there is no reason to believe that the quality of teaching the system provides will be significantly improved if additional research is done.

Summary and Recommendations

As has been noted, earlier versions of the MACS BRM program have been demonstrated to improve soldier performance in marksmanship. The present system is an enhanced version that reduces the load on the instructor, has greater flexibility in that the experienced user can now establish a shot group before starting, and is more in accord with Army standards for marksmanship. However, it has not been formally validated. Indications from both in-house SMEs and U.S. Army Marksmanship Unit personnel (n=6) are that the feedback the system provides is both realistic and appropriate. From this we may conclude that the current version has face validity. If there is a need to prove to the Army that soldiers trained, in part on MACS BRM will learn more rapidly, or if there is a need to demonstrate the degree of improvement that may be gained by using the system, then it is recommended that a new system validation be undertaken.

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APPENDIX A

Summary Description of Levels

Level 1. Introduction to Supported Position

Summary description

- No time limit
- Supported position
- Single-target presentations
- Eighteen targets presented, three targets at each of six ranges
- Targets engaged in order of range: 50, 100, 150, 200, 250, and 300 m

Feedback

- Words **HIT** or **MISS** appear on screen for each shot
- Cross appears on screen to show bullet strike
- Diagnostics and replay are shown after each shot
- Screen shows three rounds on single target after each group of three shots
- Summary screen at end of level shows average diagnostic scores

Standards

- Two hits out of three shots at each range within level. Failure to meet standard at a given range results in immediate refire of 3 more targets at that range. Refires continue until standard is met
- Refire of level is required if any score on summary screen is **BELOW AVERAGE** or **POOR**

Level 2. Introduction to Unsupported Position

Identical to Level 1, with these exceptions:

- It is fired in the unsupported position
- Shooter is regressed a level if any 2 scores on summary screen are **POOR**

Level 3. Timed Targets in Supported Position

Summary description

- Time limit approximately one-and-one-third times that for record fire
- Supported position
- Single target presentations
- Twenty-four targets in random sequence (four presentations per range)

Feedback

- Cross appears on screen to show bullet strike
- For a hit, target disappears immediately after bullet strike is shown
- Diagnostics and replay are shown after bad shots only. Criteria for bad shot is a POOR for any score or a BELOW AVERAGE for shot location
- Audible tone when target exposure time limit has expired
- Summary screen at end of level showing average diagnostic scores
- Summary screens showing four shots at each range on single targets

Standards

- Three hits out of four shots at each range within level. For each range at which this standard is not met, a refire of four targets at each of those ranges is required. Refires continue until standard is met
- Refire of level is required if any score on summary screen is BELOW AVERAGE or POOR
- Shooter is regressed a level if any two scores on summary screen are POOR

Level 4. Timed Targets in Unsupported Position

Identical to Level 3, with these exceptions:

- It is fired in the unsupported position
- Standard is relaxed. Three hits out of four shots at 50, 100, 150, and 200 m, and two hits out of four shots at 250 m and 300 m

Level 5. Practice Record Fire I

Summary description

- Time limit same as for record fire
- Supported and unsupported positions
- Single or double presentations
- Forty targets in random sequence, 20 fired supported and 20 unsupported.

Feedback

- Cross appears on screen to show bullet strike (hit and miss)
- For a hit, target disappears after bullet strike is shown
- Audible tone when target exposure time limit has expired
- OUT OF AMMO appears on screen when 20 shots have been fired
- Interim summary of shot location (hits, misses, and no fires) given at end of each position and final summary at end of course of fire
- Summary screens showing shots at each range on a single target at end of supported position and at end of unsupported position
- Performance graded as Expert, Sharpshooter, Marksman, Unqualified

Standards

- Fifteen hits out of 20 shots in both supported and unsupported positions. Refire of position if standard not met
- On double target exposures, a penalty is recorded if further target is engaged first
- Regress one level for average shot location score of POOR. Stay at same level for mean shot location score of BELOW AVERAGE. Otherwise pass

Level 6. Practice Record Fire II

Identical to Level 5, with the exception that the cross showing bullet strike appears only after misses. Target disappears when hit.

Level 7. Record Fire

Summary description

- Time limit same as for record fire
- Supported and unsupported positions
- Single or double presentations
- Forty targets in random sequence, 20 fired supported and 20 unsupported

Feedback

- Targets disappear when hit
- OUT OF AMMO appears on screen when 20 shots have been fired
- Audible tone when target exposure time limit has expired
- Interim summary of shot location (hits, misses, and no fires) given at end of each position and final summary at end of course of fire
- Summary screens showing shots at each range on a single target at end of supported position and at end of unsupported position
- Performance graded as Expert, Sharpshooter, Marksman, Unqualified
- Cross appears on screens to show bullet strike for misses, whenever soldier has to refire level

Standards

- Fifteen hits out of 20 shots in both supported and unsupported positions. Refire of position if standard not met
- On double target exposures, a penalty is recorded if further target is engaged first
- Regress one level for average shot location score of POOR. Stay at same level for mean shot location score of BELOW AVERAGE. Otherwise pass

Level 8. Rapid Record Fire I

Identical with Level 7, except that the exposure times of targets are two-thirds of those used in record fire.

Level 9. Combat Fire

Summary description

- Time limits variable, dependent on number of targets presented
- Supported and unsupported positions
- Single, double, and multiple presentations
- Eighty targets in two attack/retreat scenarios each of 40 targets.
First scenario is fired supported and second unsupported

Feedback

- Targets disappear when hit
- OUT OF AMMO appears on screen when 40 shots have been fired
- Summary of shot location (hits, misses, and no fires) given at end of supported position and at end of unsupported position
- Summary screens showing shots at each range on a single target at end of supported position and at end of unsupported position
- Performance graded as Expert, Sharpshooter, Marksman, Unqualified
- Cross appears on screens to show bullet strike for misses, whenever soldier has to refire level

Standard

- Twenty-three hits out of 40 shots in both supported and unsupported positions. Refire of position if standard not met

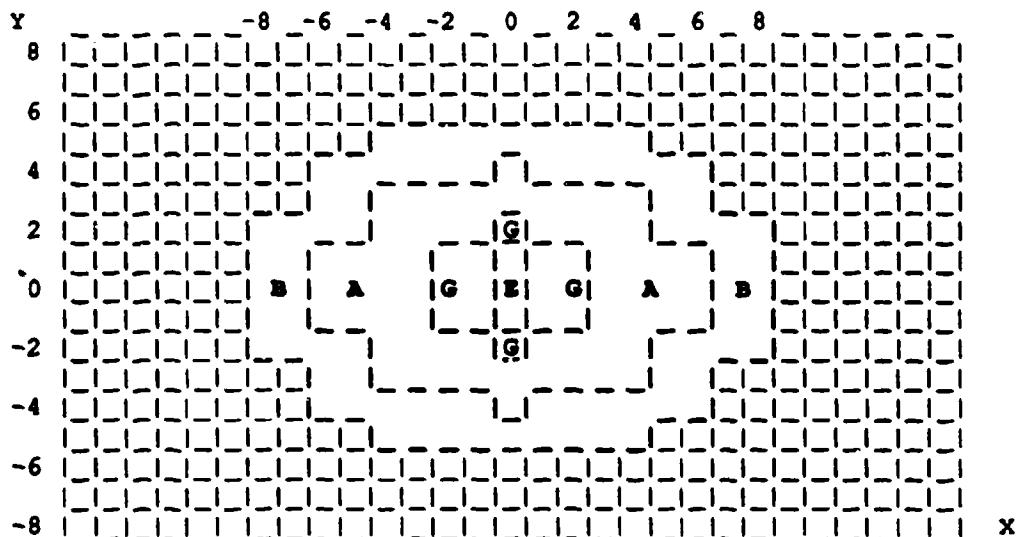
APPENDIX B

Criteria Target Areas for Aiming and Shot Location

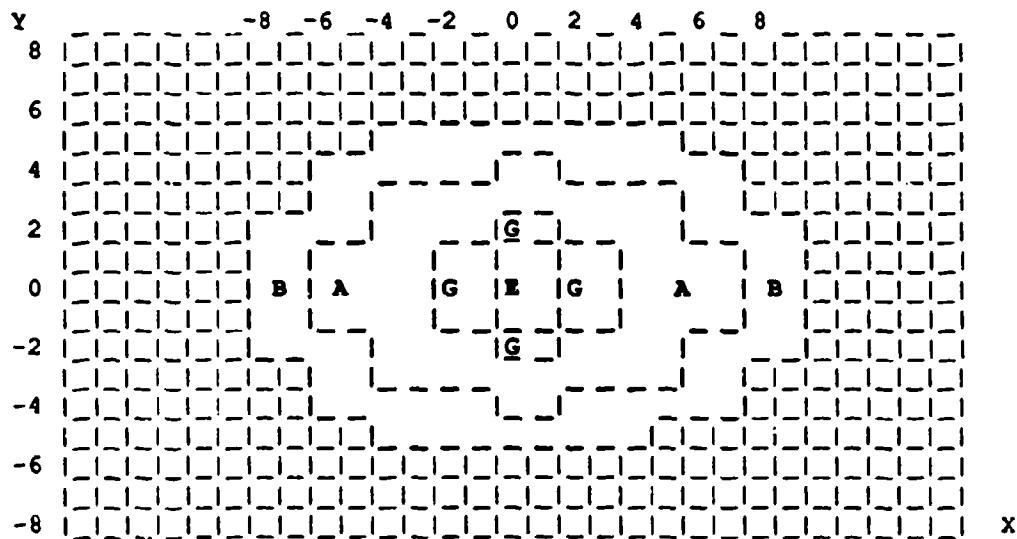
The target area that is mathematically defined for the aiming and shot location scores differs from the effective target area that was shown in the main text. For comparison purposes, both are shown in Figure B-1. The reason that the effective target area is different is as follows. The computer stores the X and Y coordinates of a pixel location each as a single byte. One byte can hold the record of any value between 0 and 255. The screen is 200 pixels high, and therefore each pixel location in the Y axis can have a separate 1 byte address. However, this is not possible in the X axis because the screen is 320 pixels wide. Because only one byte is allocated to describe the X axis location, the computer divides the number of the pixel by two before storing it. Thus, pixel number 300 is stored as pixel number 150, and when the pixel number is retrieved from memory, its stored value is doubled to recreate its original value. Unfortunately, when a number is halved and stored, it is stored as an integer so that any fractional values are lost. Thus, pixel number 301 is not stored as 150.5, but as 150; when it is retrieved, it is doubled and becomes 300. Therefore, if the light pen is focused on an odd-numbered pixel in the X axis, it is reported by the computer as the value of the pixel immediately to its left.

This system peculiarity has two implications: First, targets must be (and are) located with their centers of mass on even-numbered pixels in the X axis (were it otherwise, a score of excellent would be impossible to obtain). Second, the target areas are distorted compared with those that were mathematically defined. In defining target areas that scale to actual areas on the 25-m zeroing target, this distortion was taken into account.

Mathematically Defined Target Area (Supported Position)



Effective Target Area (Supported Position)



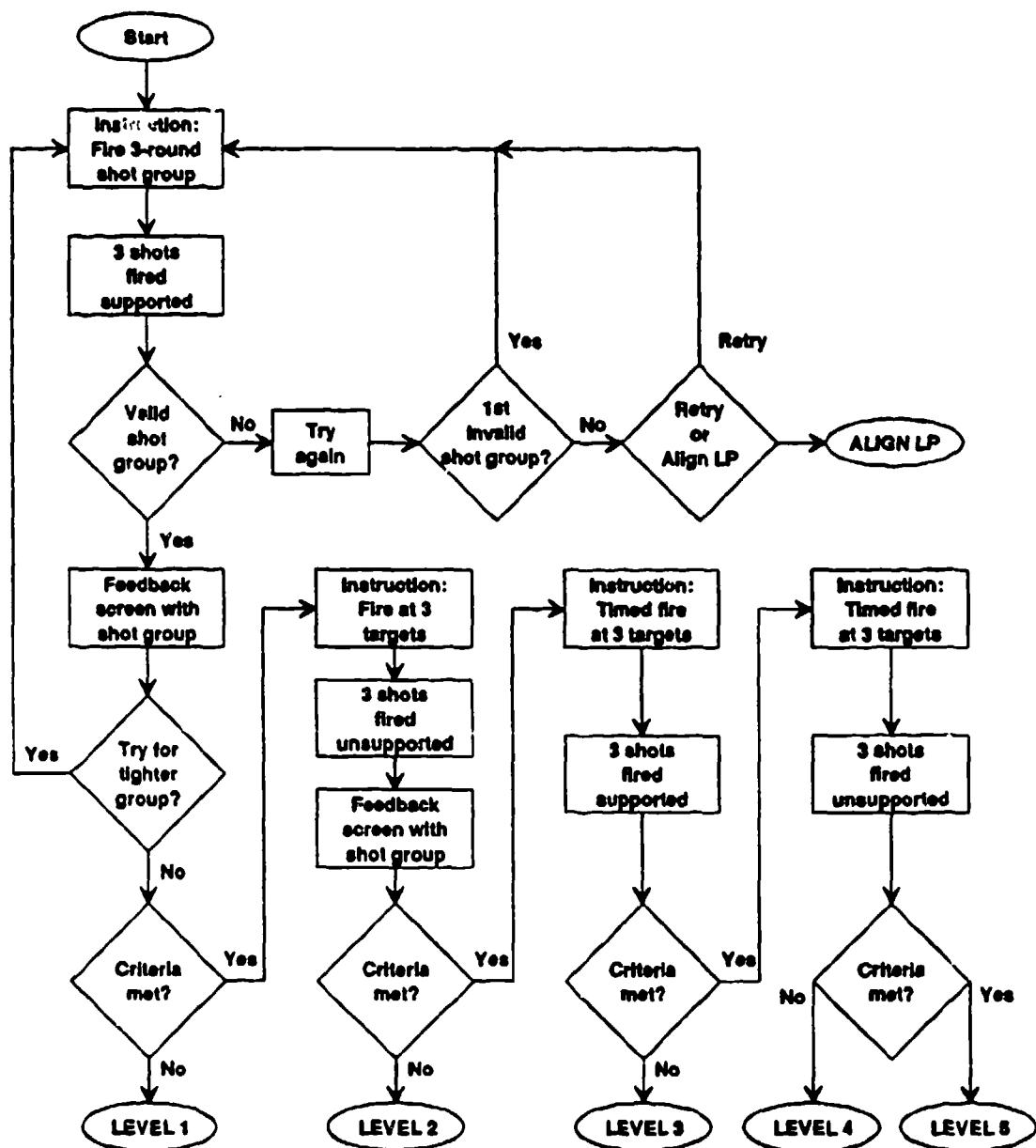
Key. E = Excellent G = Good A = Average B = Below Average
Shots located outside the indicated areas are rated POOR

Figure B-1. Comparison between mathematically defined target area, and the effective target area.'

'The effective target area is adjusted for the fact that the computer reports readings from an odd-numbered pixel in the X axis as having the same value as the pixel immediately to its left. Actual pixels are longer in the Y axis than in the X axis (approximate ratio is 1.33:1); therefore, the on-screen target area is more circular in shape than is shown.

APPENDIX C

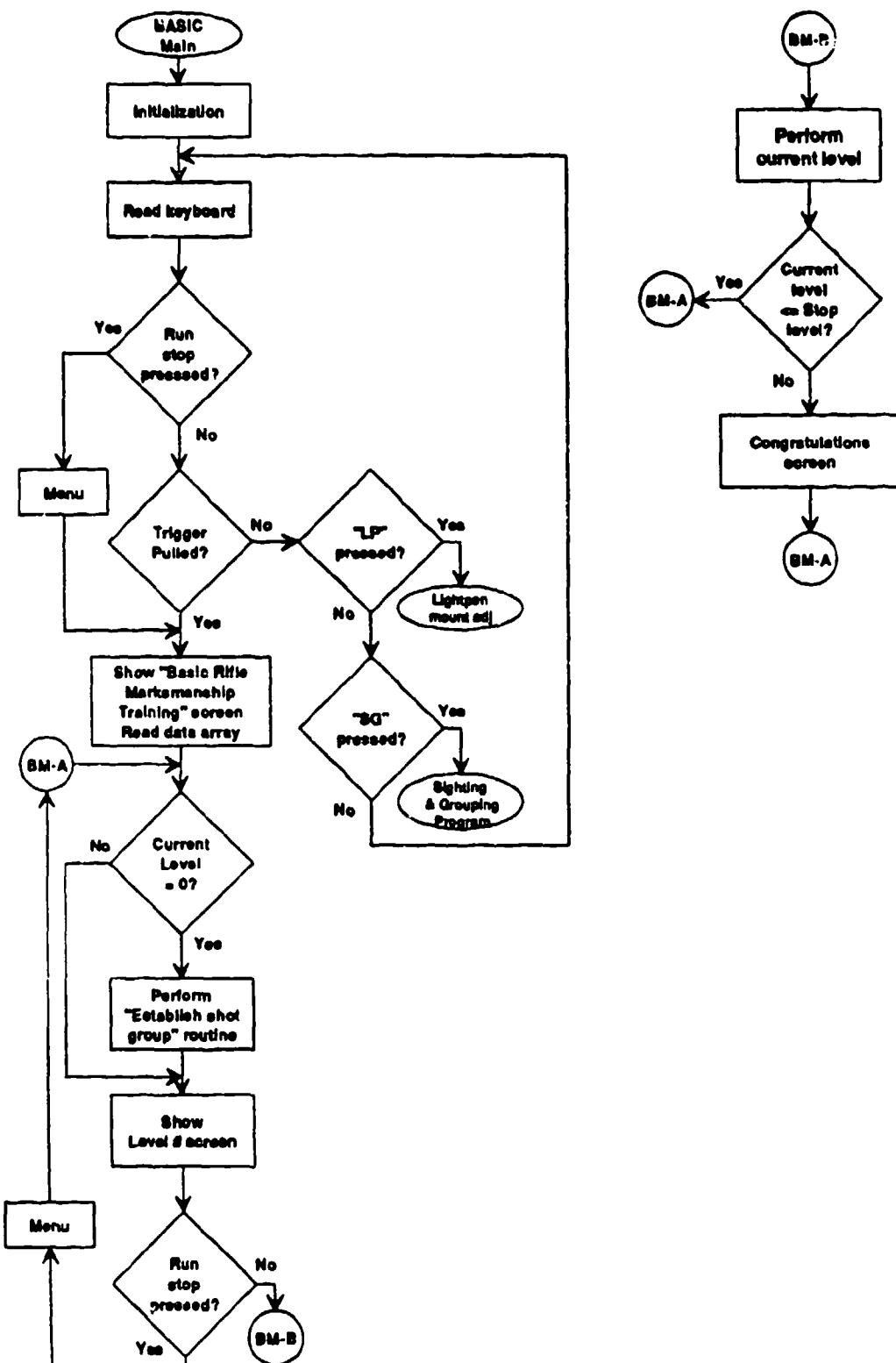
Users' Flow Chart for the Marksmanship Skill Tests¹

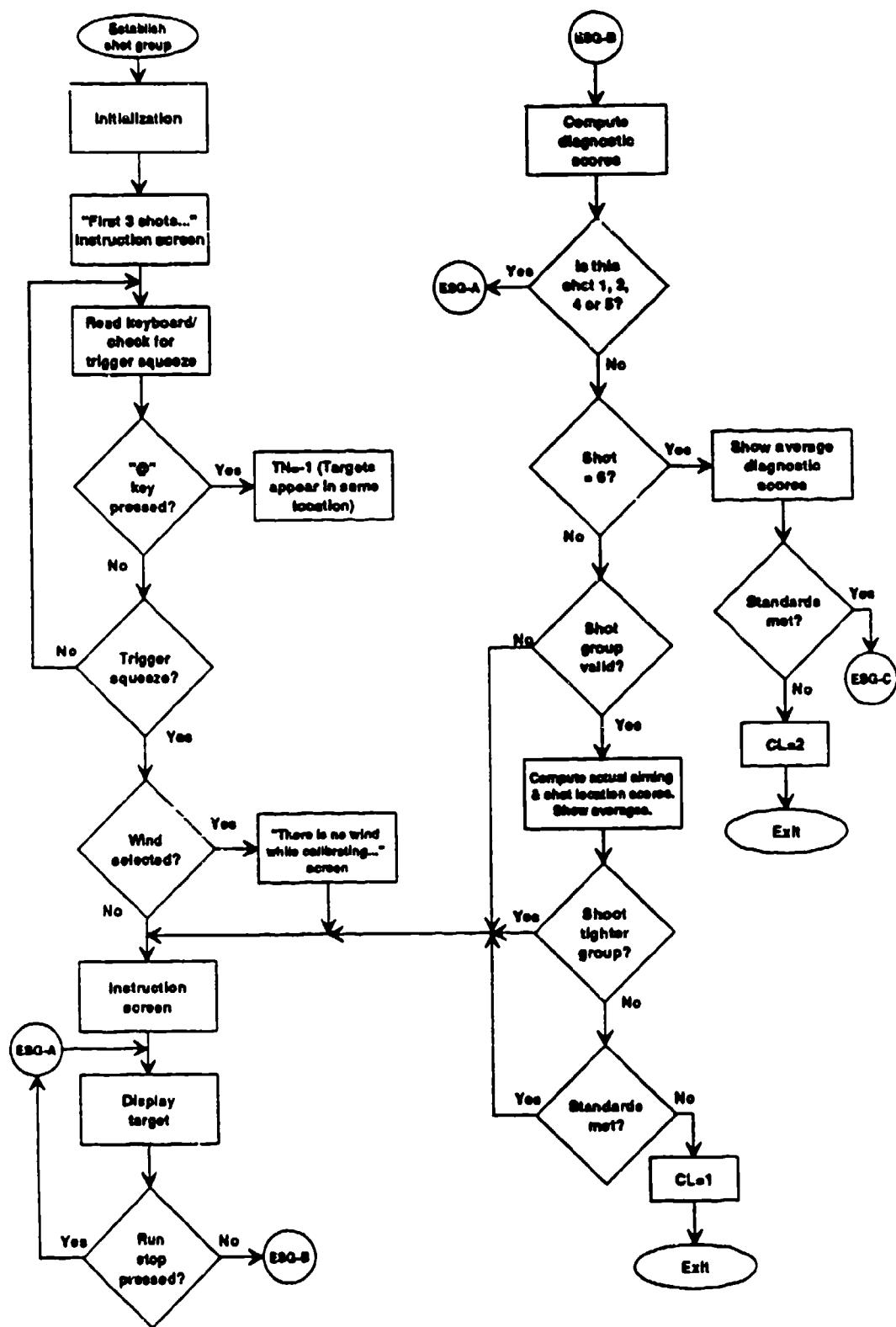


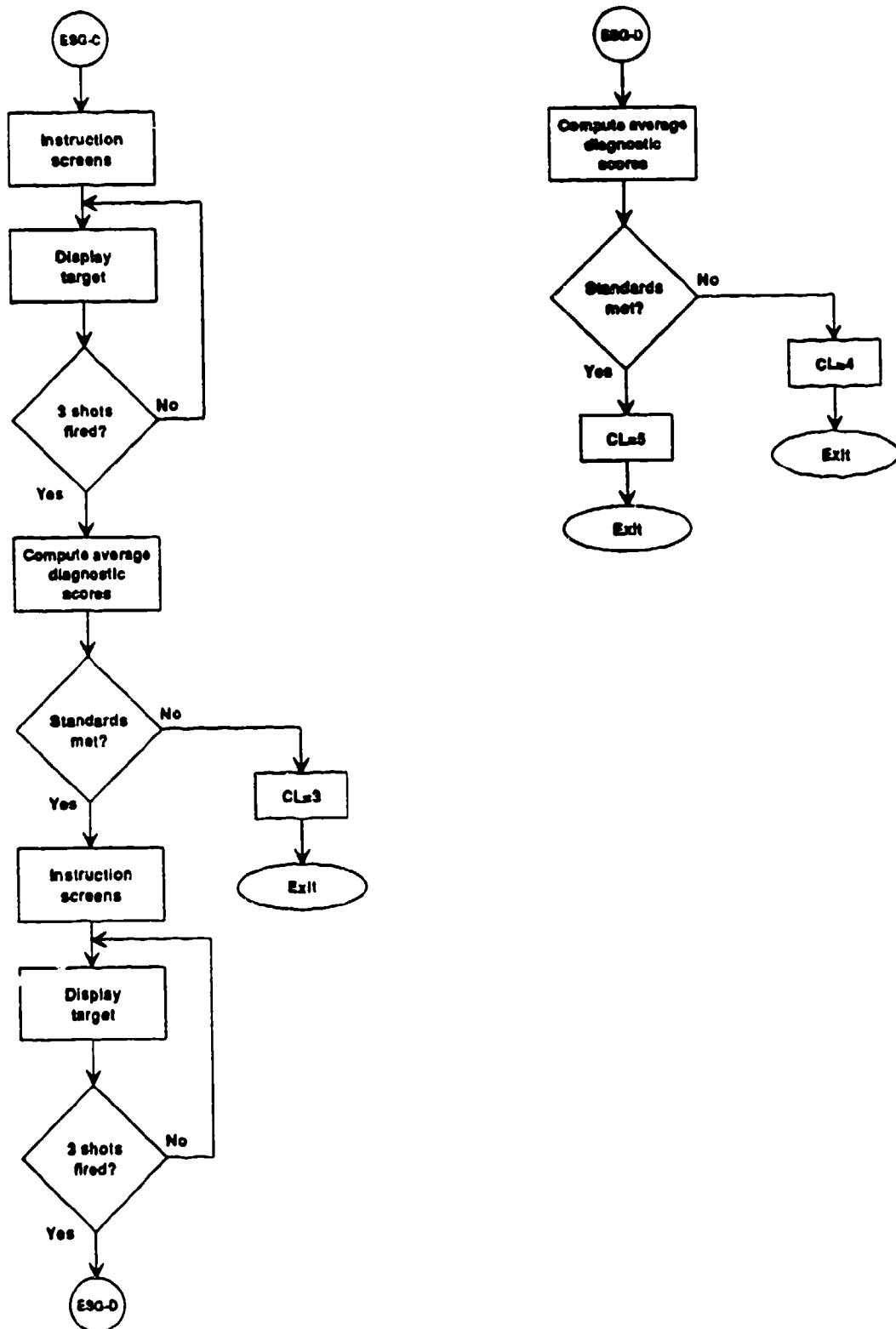
¹Initial Skill Test Criteria - For the measures of shot location, steady position, aiming, and trigger squeeze, the firer must earn two ratings of GOOD and two ratings of EXCELLENT to pass each test. The firer does not see ratings after the second test.

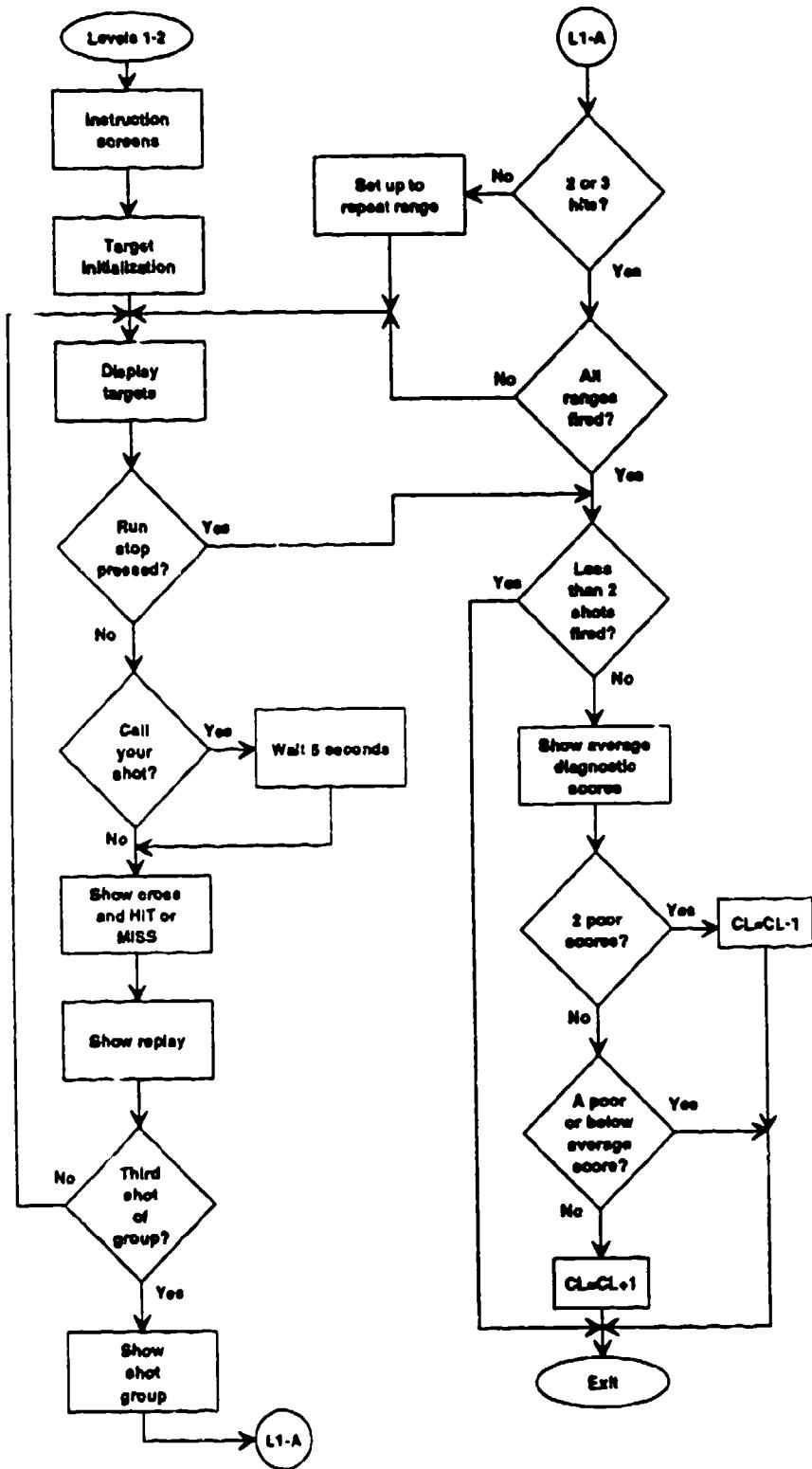
APPENDIX D

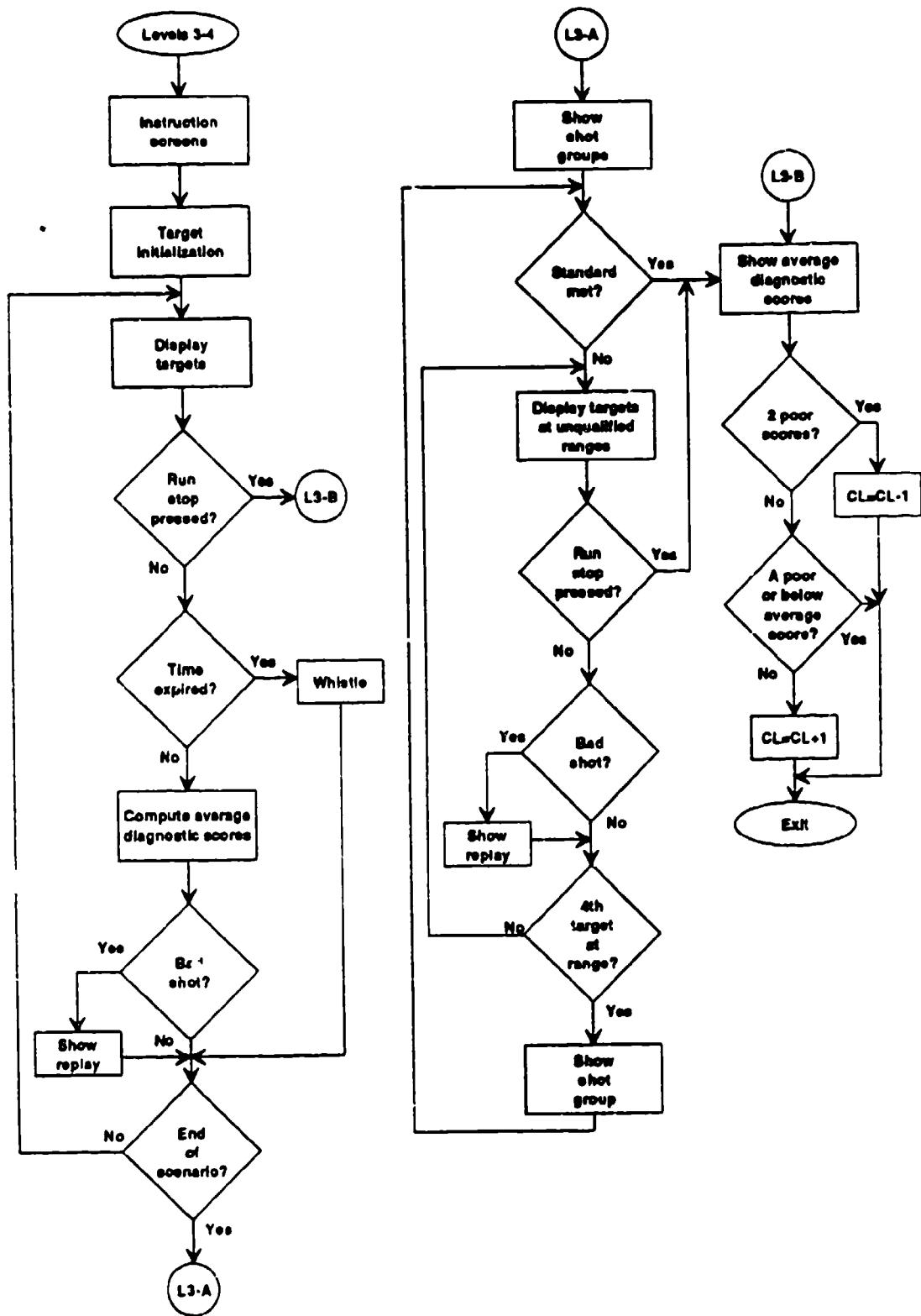
Programming Flow Chart for the BRM Program

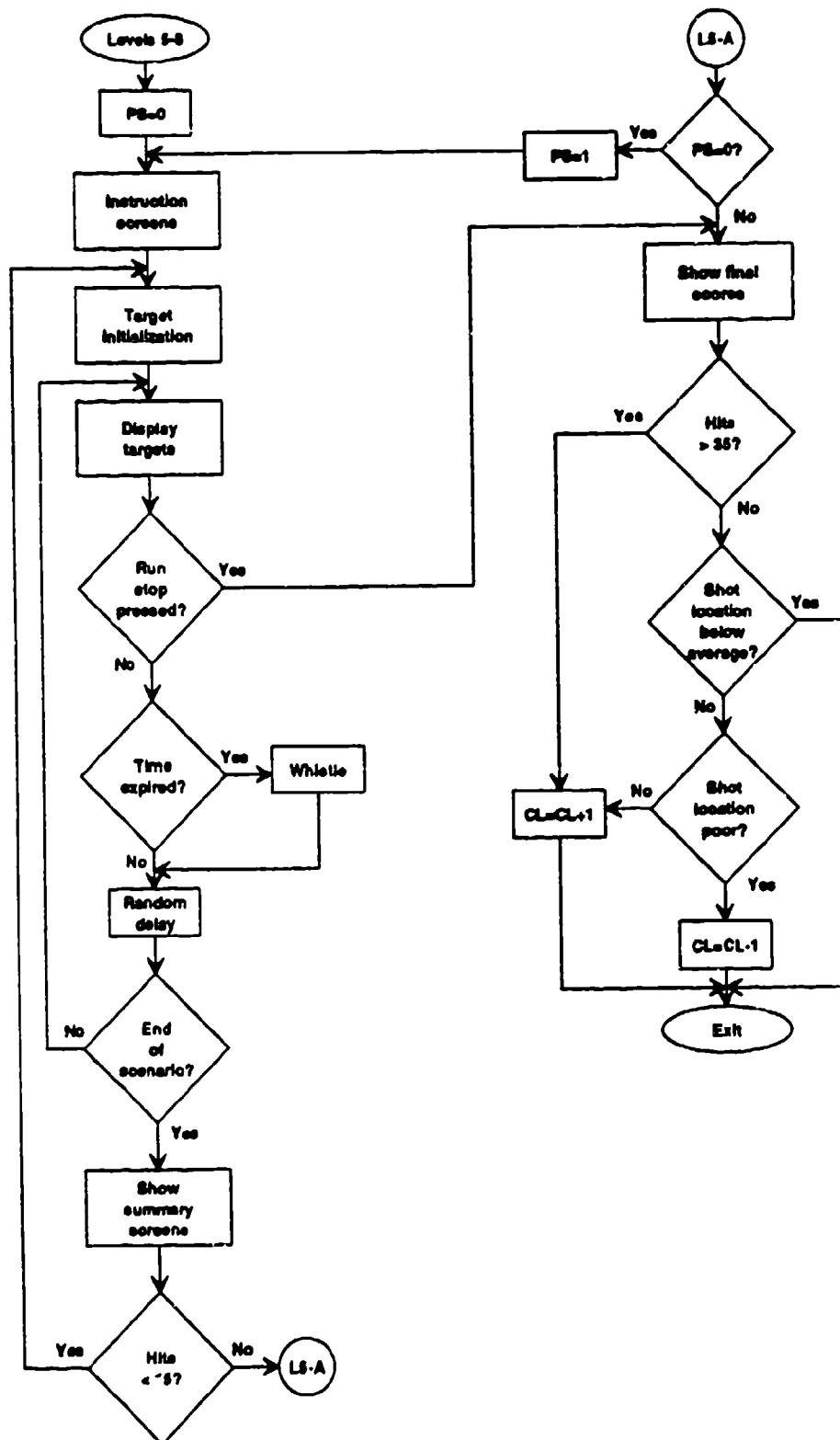


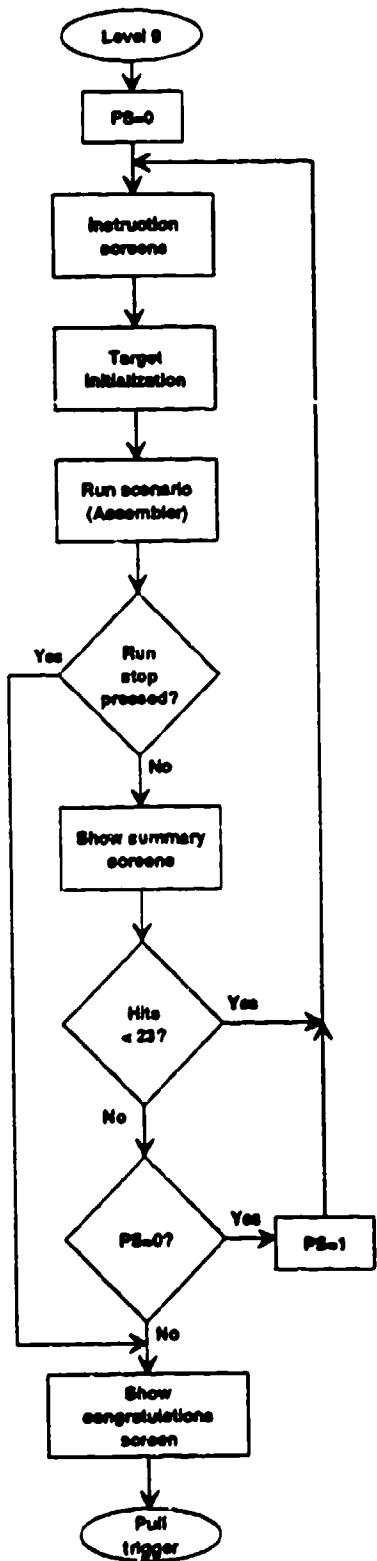


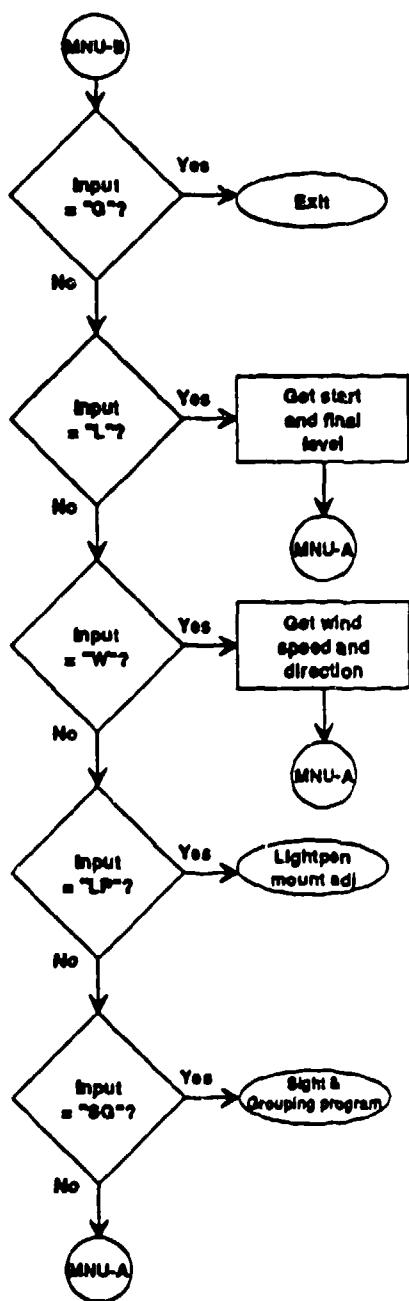
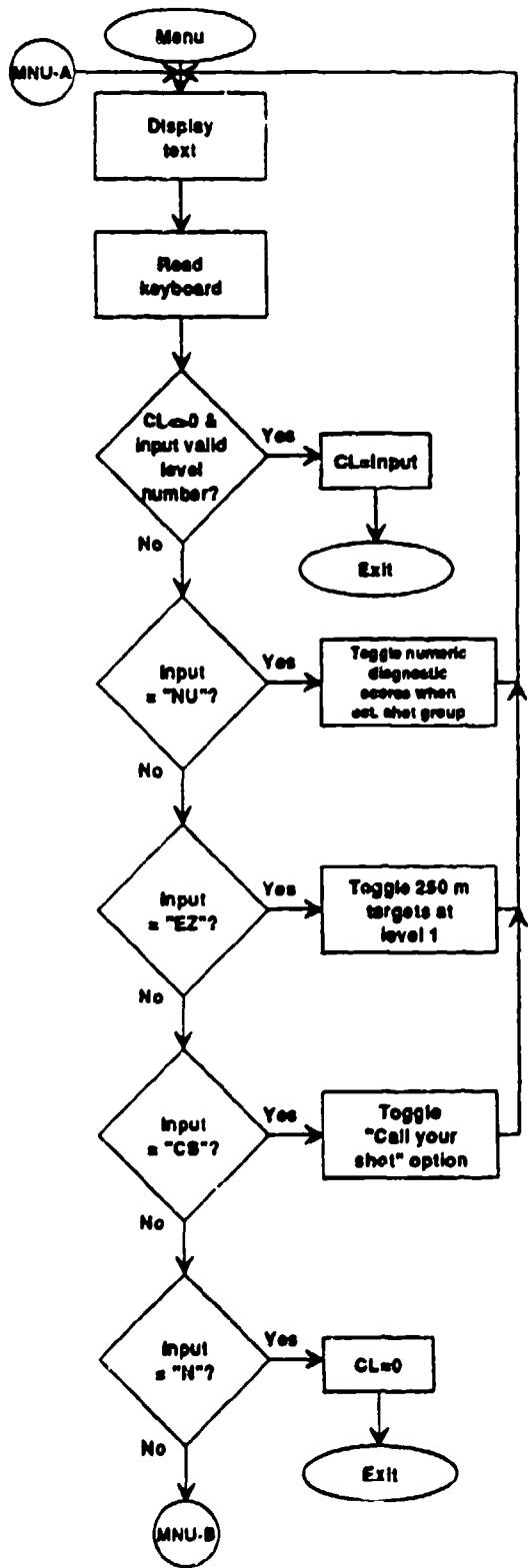


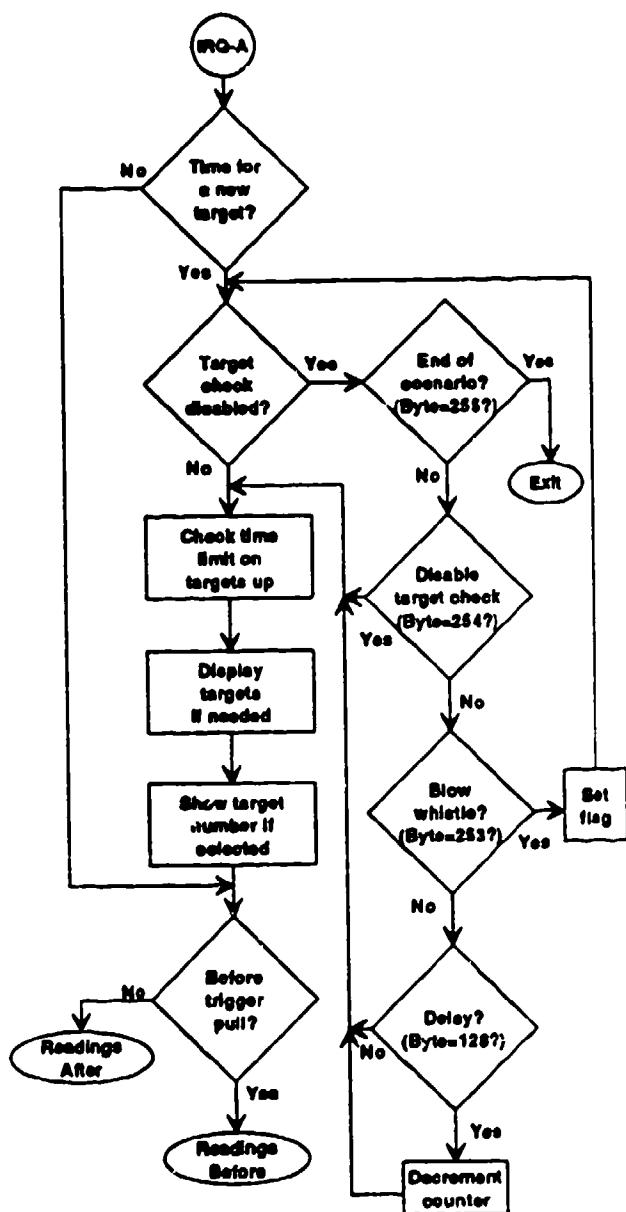
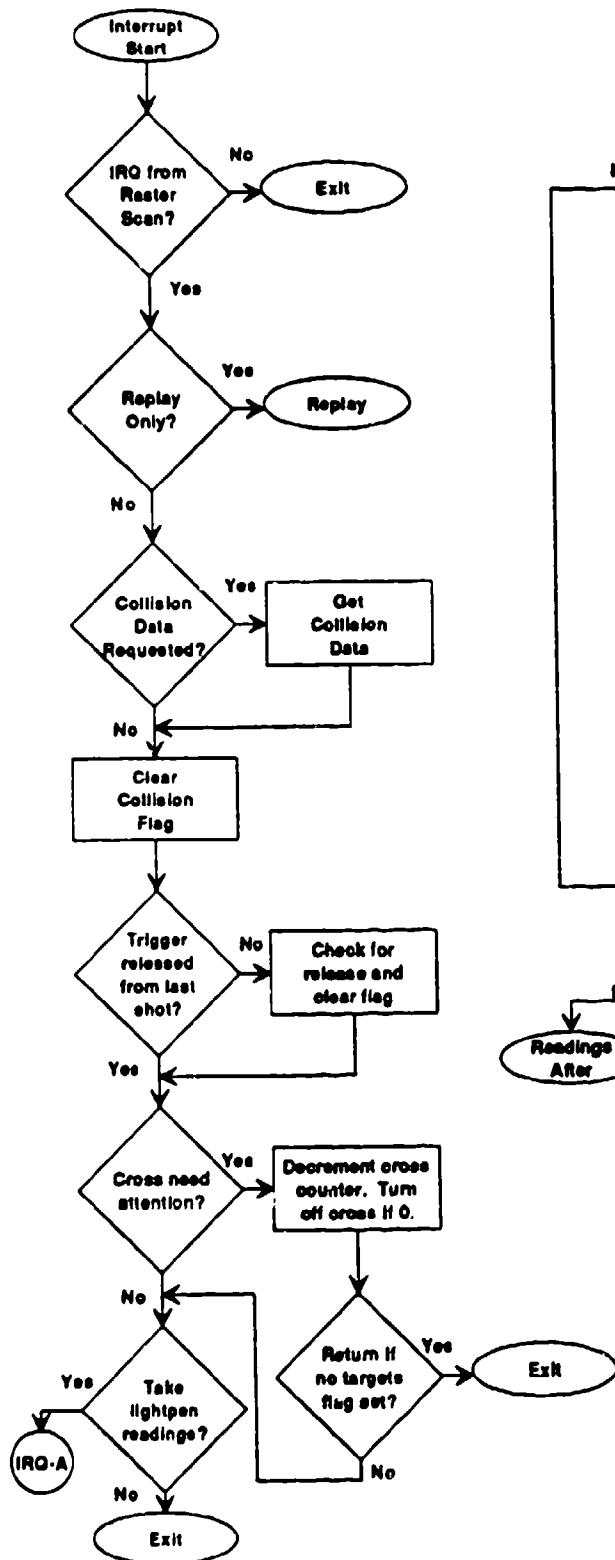


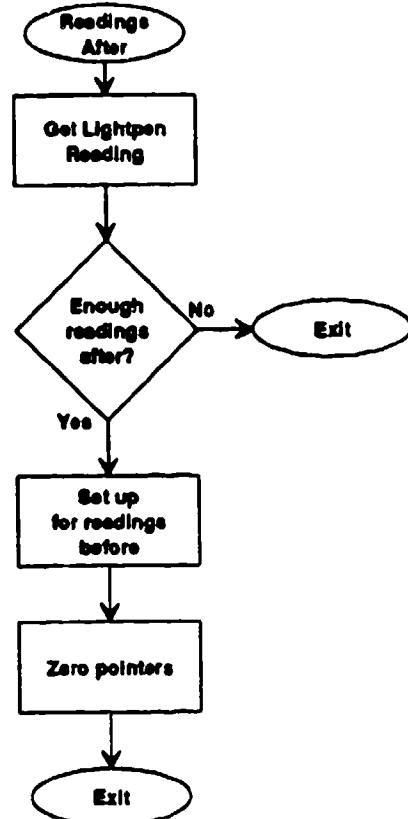
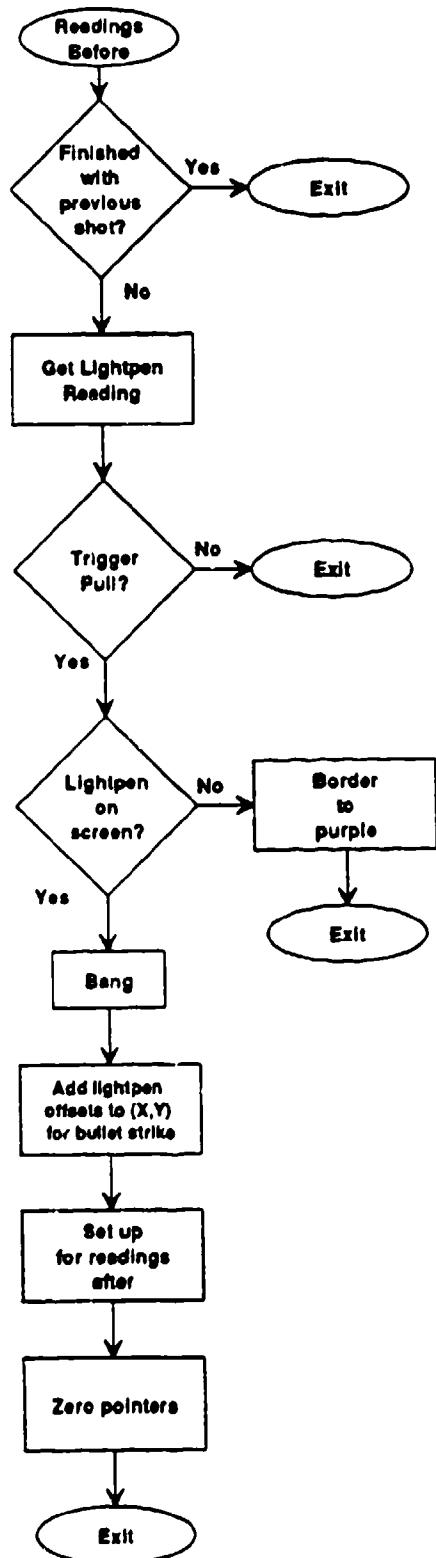


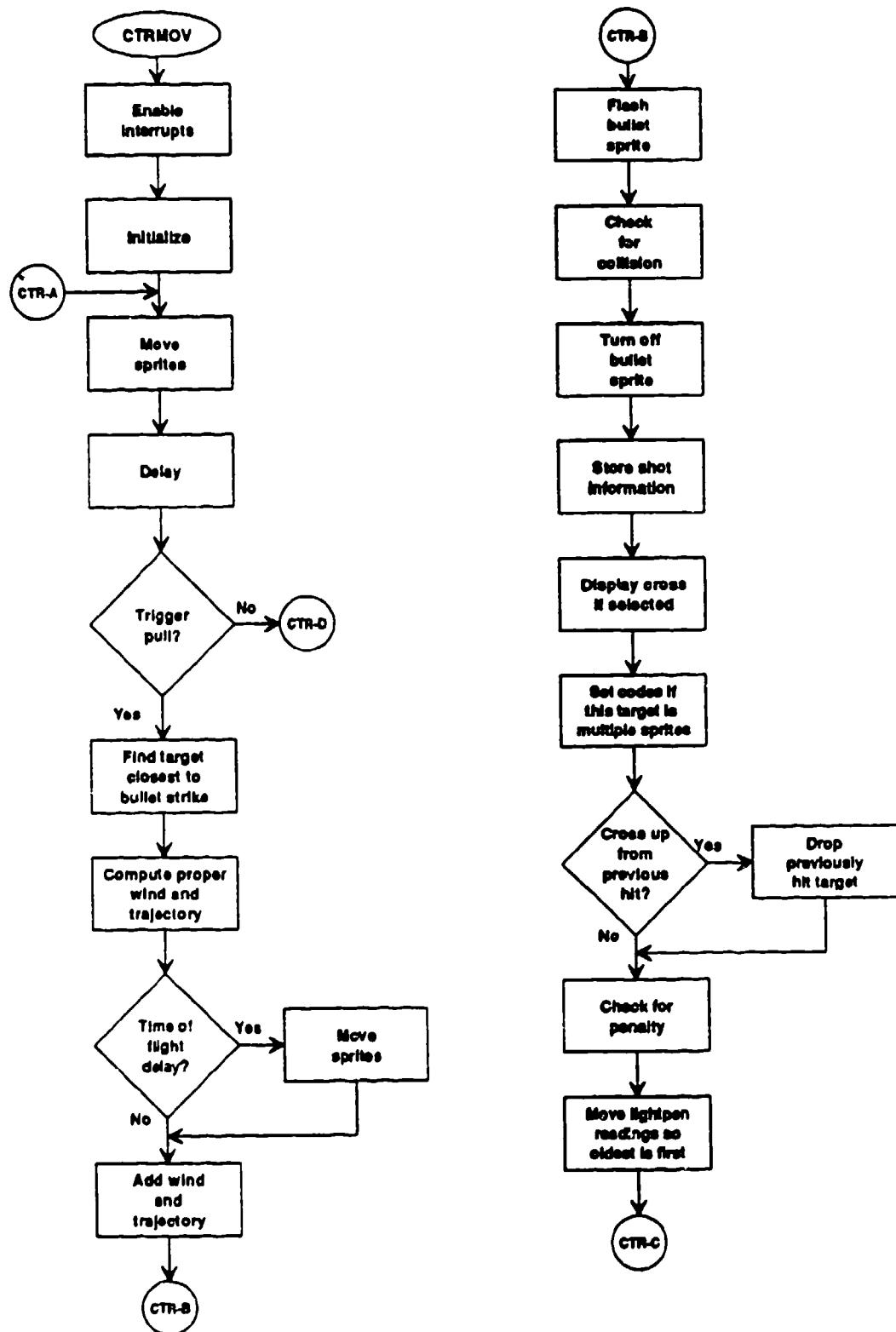


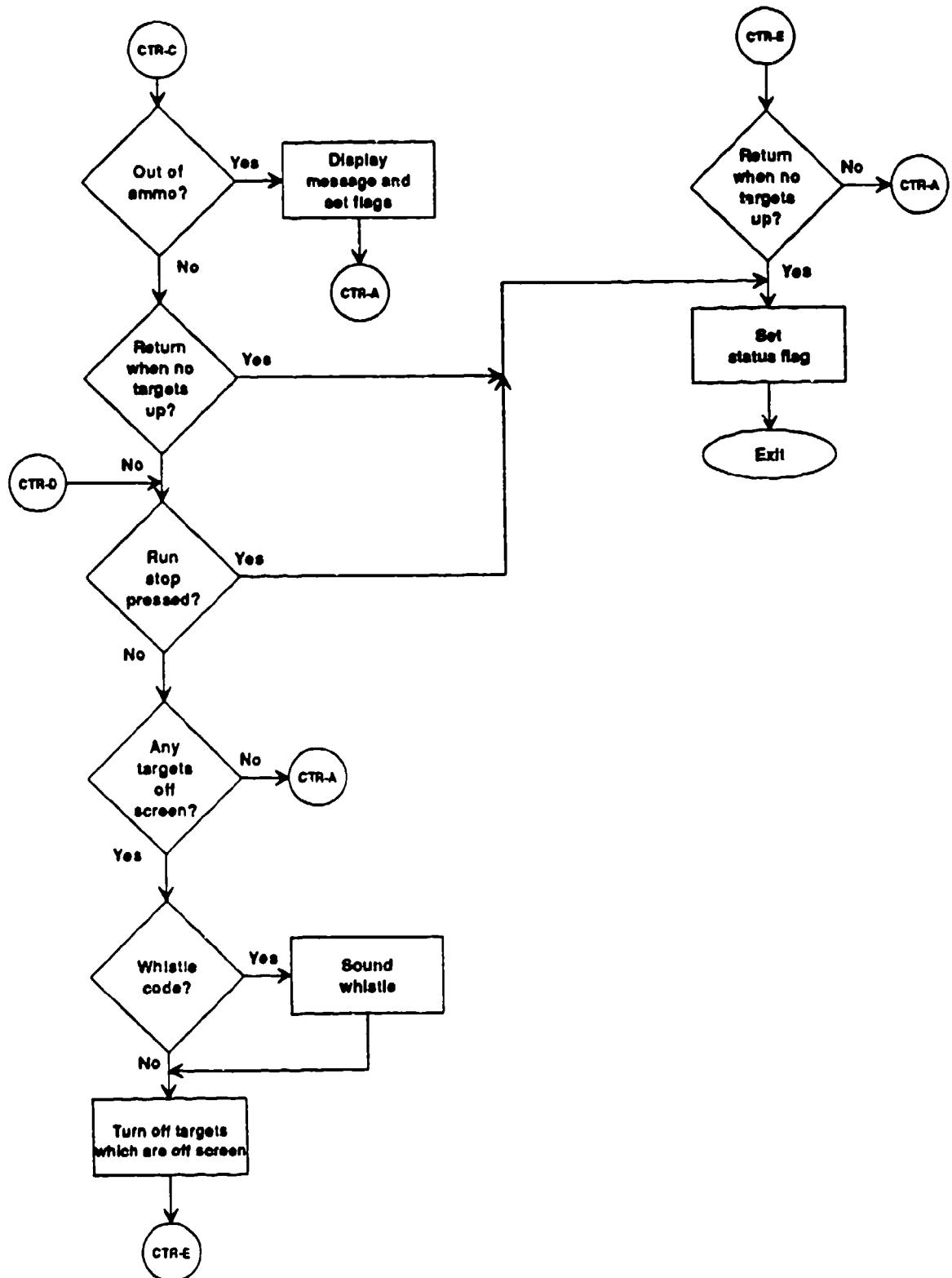


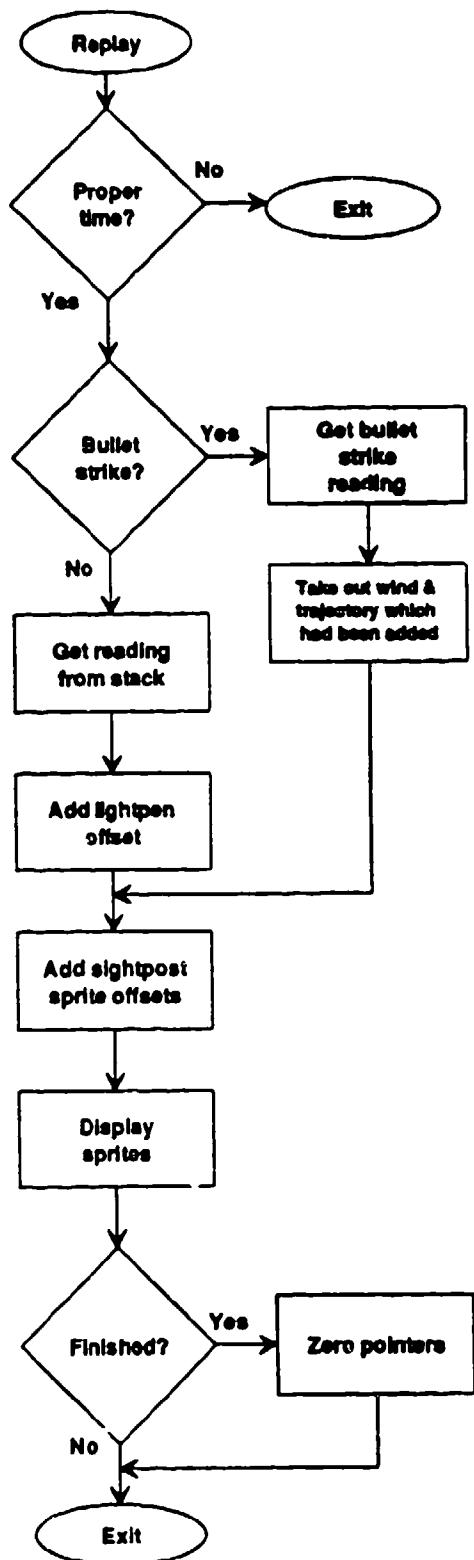






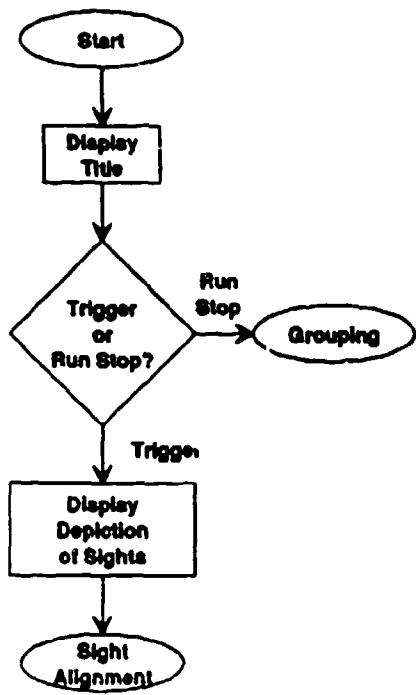


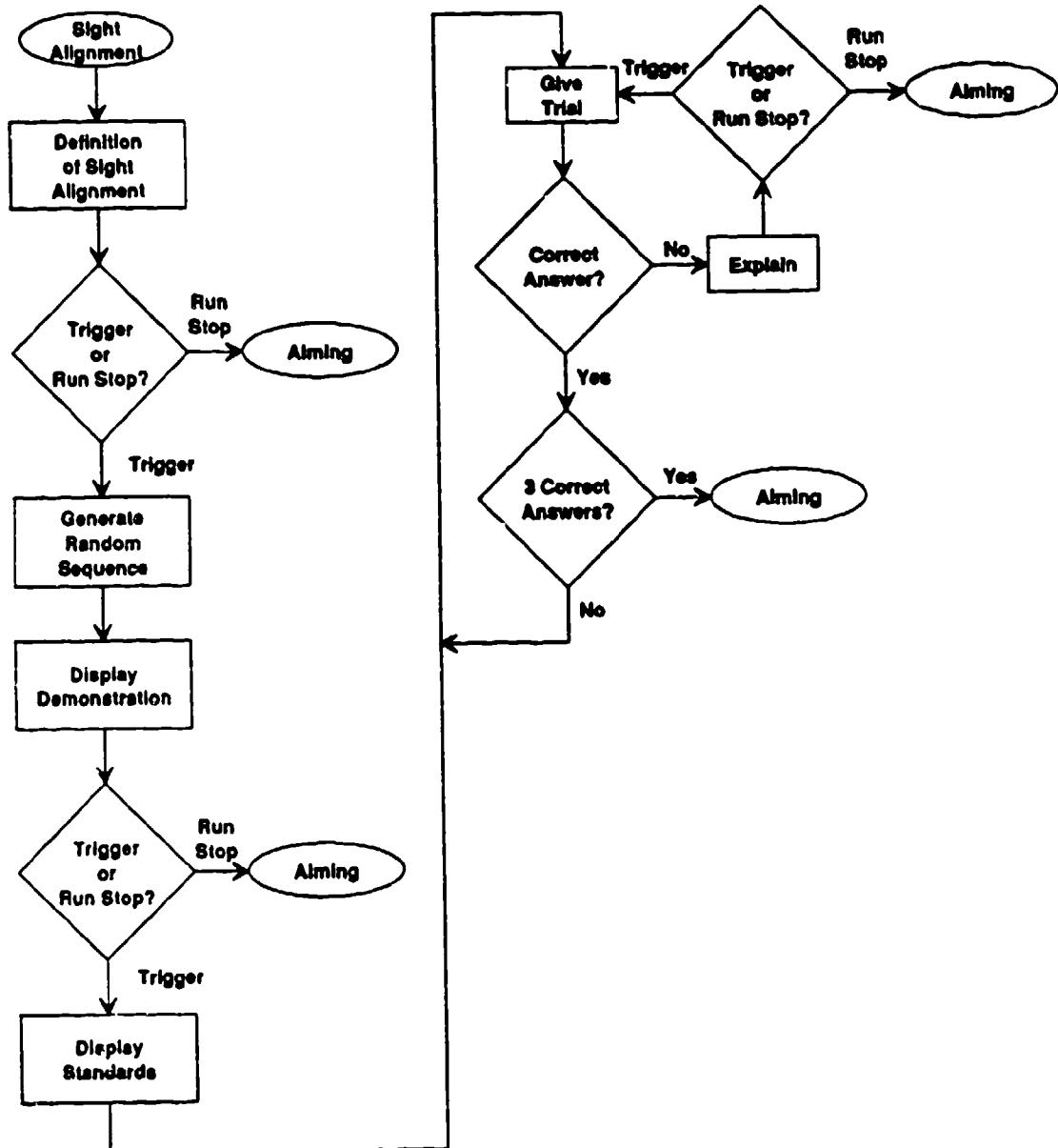


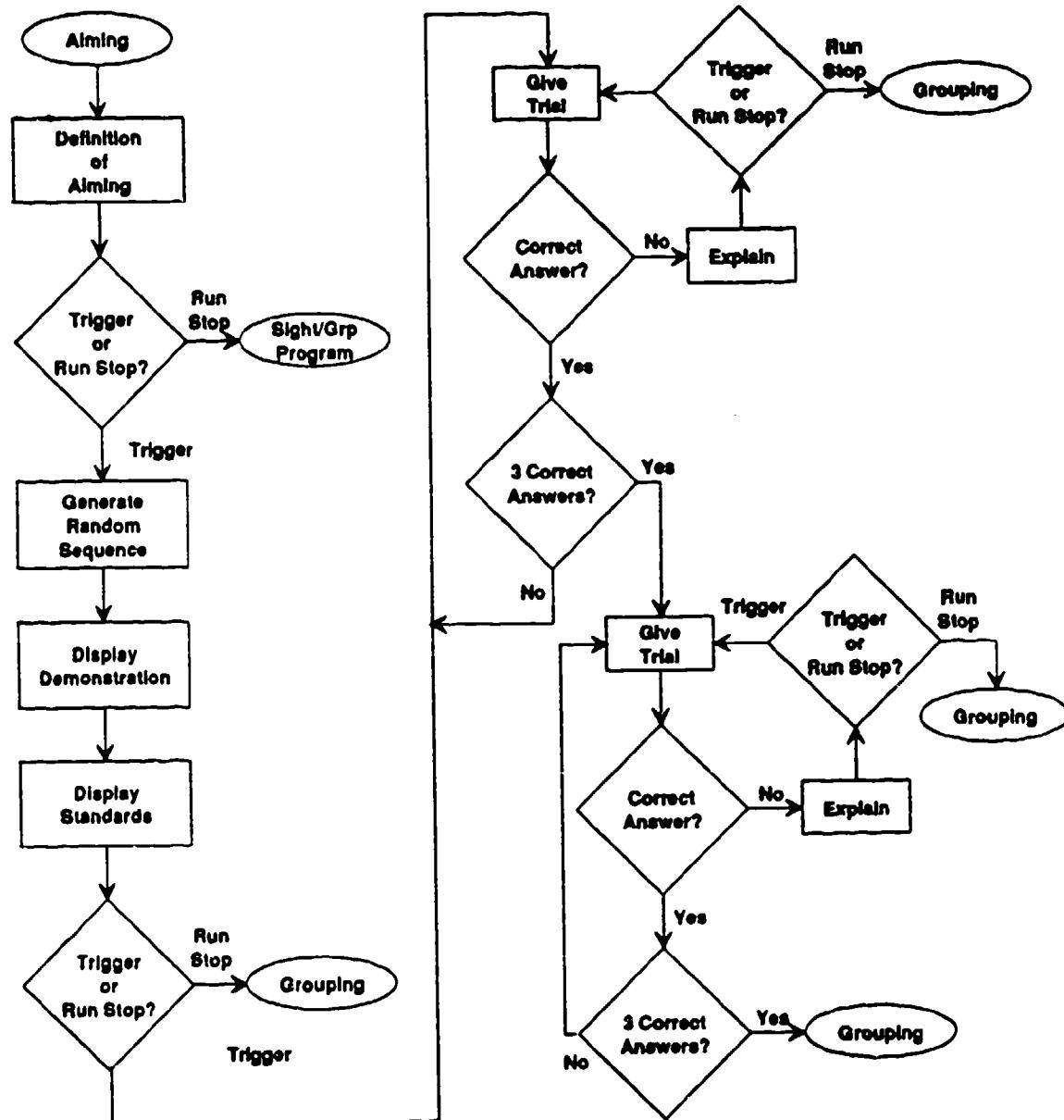


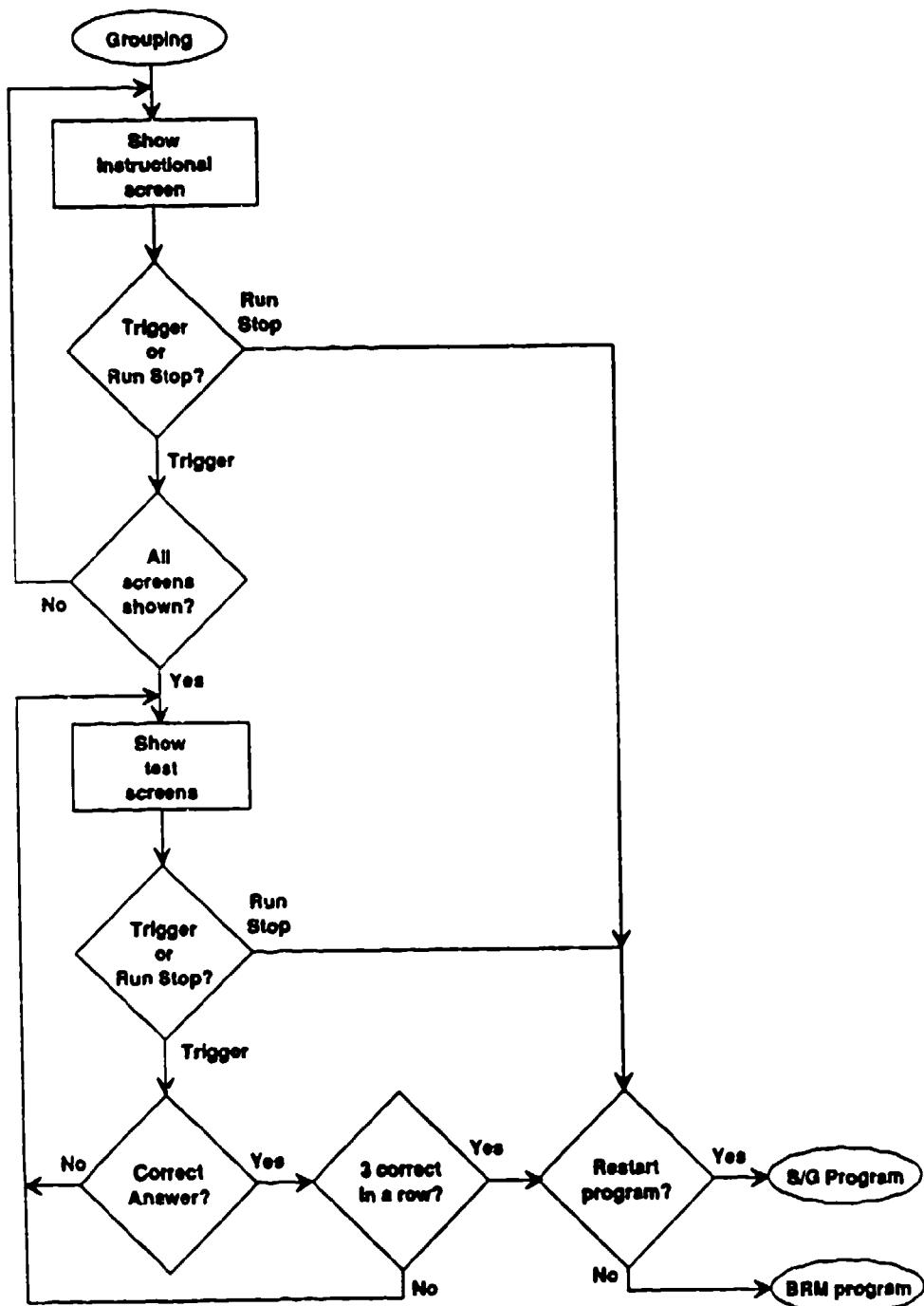
APPENDIX E

Programming Flow Chart for the Sight Alignment and Grouping Program









APPENDIX F

BRM Program Documentation

Basic Hierarchy Chart.

Lines 10-310: Main program driver.

Lines 1000-2890: Subroutines for firing levels.

Lines 1000-1640: Establish shot group/extended skills tests procedure.

Lines 1650-1930: Firing levels 1 and 2.

Lines 1940-2300: Firing levels 3 and 4.

Lines 2310-2730: Firing levels 5-8.

Lines 2740-2890: Firing level 9.

Lines 3000-5860: Supporting subroutines.

Lines 6000-6140: Data.

Lines 10-310: Main program driver.

Lines 10-70: Initialize variables.

Lines 80-120: Lines 80-310 form the main loop of the program. At this time, the BRM cartridge opening screen is being shown alternatively with the high scorer screen (after someone has fired). These lines poll the keyboard for the spacebar, the break key, or the "LP" or "3G" key combinations which enter the 9-level scenario, go to the menu, or run the light pen mount adjustment, or sighting and grouping programs respectively.

Lines 130-220: Line 130 transfers control to line 230 if variables have been initialized and the option of record keeping has been established. Otherwise, these lines welcome the user to MACS, and initialize array variables.

Lines 230-310: These lines send the firer first to the zeroing routine, and then to the appropriate level of fire. Upon completion of the exercises, the congratulations screen is displayed and control returns to the top of the program at line 80.

Lines 1000-1640: Establish shot group/extended skills tests procedure.

Lines 1000-1010: If the record keeping option has been specified, the user must now input the firer's identification number.

Lines 1020-1120: These lines show the instructional zeroing screen and check for the trigger to be pulled, or the "@" key to be pressed. If the trigger is pulled, the variable TN is set to 0 and the zero targets are shown with a random horizontal (X) value. If the "@" key is pressed, TN is set to -1 and the zero targets are displayed with the same X value (165). The machine language routine which draws expanded targets from the sprite data (referenced by the BASIC variable DT) is called to draw the 150-meter target (expanded to 50 meters). Line 1050 calls this routine and shows a center dot representing center of mass of the target.

Lines 1130-1150: These lines initialize the variables needed by the interrupt routines and copy the zero target data from its permanent location on the EPROM to its useful place in RAM. This routine is referenced by the BASIC variable DA.

Lines 1160-1200: If the shot number is 0 or 3, i.e., if the user is about to fire the first shot of either firing position, the accumulator for the average diagnostic scores (for the summary) is set to 0 and the firer is instructed to assume the proper position. The high resolution graphic screen must also be displayed at this point.

Lines 1210-1220: The appropriate X coordinate (either 165 or random, as determined by the value of TN) is put into the target data.

Line 1230: The target control and lightpen reading routine is called. If the routine returns to BASIC as a result of the break key's being pressed, control returns to line 1210 and the firer engages another target without advancing the shot counter.

Line 1240: Compute the diagnostic scores.

Lines 1250-1270: If the shot count is less than 3, the lightpen offset x and y values (OX and OY) are incremented. Each (X,Y) coordinate for bullet strike is examined to make sure it is within a range left and right of the target and immediately below. This range is the same as in the calibration program, assuming the calibration cross is the center of mass of the 250 meter target now being fired at. If a shot is determined to be out of range, the flag BC is set to 1.

Lines 1280: The accumulators for the average steady position and trigger squeeze scores are adjusted. Only these two scores can be computed now because no lightpen offset has been determined.

Lines 1290-1440: These lines are executed only if the shot count is at 2 (after the third shot has been fired). If a shot was determined to be out of range, the message "INVALID SHOT GROUP, TRY AGAIN" is displayed. If this is not the first invalid shot group, the additional prompt "CHECK CALIBRATION (SEE MANUAL)" is shown. The firer must then repeat the calibration process at line 1130 or press the stop key and enter the calibration program. If all shots were in range, the lightpen offsets can now be determined since the zeroing process has been completed, and the aiming and shot location scores for the first three shots can be computed (SYS 3427). The three-round shot group and summary diagnostic scores are shown. If the summary scores meet the standard, the firer fires three more shots. If the standard was not met, the program returns to line 230.

Line 1450: If the shot count is less than 6, the program loops back to line 1160.

Line 1460-1470: The shot location scores for shots 3-5 are computed and the three-round shot group and summary diagnostic scores are shown.

Lines 1480-1490: The program determines a starting level or continues to the extended skill test. If no further testing is required, control is returned to line 230.

Lines 1500-1540: Variables for the extended skill test are set up and the introductory screens displayed.

Lines 1550-1640: Either three or six more shots are fired in this loop for the extended skill test. These lines proceed in similar manner to the regular skill test with the exception of line 1570, which must now consider the possibility of a no fire. Control is returned to line 230 upon completion.

Lines 1650-1930: Firing levels 1 and 2.

Lines 1650-1660: The targets are shown at all ranges and the expanded target with the "bull's eye" circles is now shown.

Lines 1570-1680: Variable initialization.

Lines 1690-1710: If the current level is 1 and the "EZ" option has been selected, only the data for 250 meter targets is moved. The line which loads all other targets is skipped.

Line 1720: This line moves the data for all targets from EPROM.

Lines 1730-1780: All variables are initialized, and the hires scenario and status line are displayed. A random X coordinate and the no time limit

code are recorded in the data for the machine language routines and the trajectory and Y coordinate are obtained from the data for use in future BASIC routines. If the 50 meter target is being engaged, the second sprite is prepared.

Lines 1790: The machine language routine target and lightpen control is called here. POKE 878,0 turns off the cross delay counter so that the cross will remain on the screen and not disappear after one half second. If the break key is pressed during engagement, control is transferred to line 1930 and the subroutine is exited.

Lines 1800-1840: If the "call your shot" option is in effect, the program displays the message "CALL YOUR SHOT: 5." Each second from 5 to 0 is counted down and displayed. When the timer reaches 0, the crosshair is displayed.

Line 1850-1870: If a hit is detected, the prompt "HIT" is shown at the bottom left of the screen. If a miss is reported, the word "MISS" appears. The replay routine is called with a check for the break key.

Line 1880: The shot counter is incremented and if it is not the third shot at any target, the target data pointer is restored to the same target and the program loops back to line 1750.

Line 1890-1910: At this point in the routine, three shots have been fired at a target. The shot group is displayed and if the number of hits is 2 or 3, the next target is engaged (beginning at line 1730). If this success comes after an earlier failure, the message 'STANDARD MET, CONTINUE.' is displayed.

Line 1920: This line indicates the firer did not pass the standards. The number of repetitions counter (RP) is incremented, the "YOU DID NOT MEET THE STANDARD. PREPARE TO REFIRE." message is displayed, the border is changed to red, the number of hits (H) is set to 0, and control is sent to line 1750 for replay of the same target.

Line 1930: All sprites are turned off, summary diagnostic scores are displayed, the next level of fire is determined, and control is returned to line 280.

Lines 1940-2300: Firing levels 3 and 4.

Lines 1940-2060: The proper instructional screens are displayed, all variables are initialized and the target data is moved to RAM in random order.

Lines 2070-2110: These lines control the firing for the first round of targets. The work horse of this routine is the subroutine beginning at line 4850, which returns (in the variable Z) 128 if the break key is pressed during the exercise, 64 for a no fire, or 0 to proceed. When all targets have been engaged once, the next set of lines are executed to handle any necessary repetitions.

Line 2120: The summary shot groups for all targets engaged are shown.

Lines 2130-2240: Shots are refired on the targets for which the firer did not qualify. Again, the main routine is the subroutine beginning at line 4370.

Lines 2250-2300: The average diagnostic scores are computed and displayed and the next level of fire is determined. Control is returned to line 280.

Lines 2310-2730: Firing levels 5-8.

Lines 2310-2410: Instructional screens are displayed, all variables are initialized and the target data for the appropriate level (supported position) are moved to RAM.

Lines 2420-2460: The main routine at subroutine 4510 is called in line 2420. A summary of hit, miss, no fire, accuracy, and penalties is shown after firing. If the break key was pressed during engagement, the subroutine is exited. After shot groups are shown, the program checks to see if the standards have been met and either returns to line 2380 or continues to the unsupported position.

Lines 2470-2530: Instructional screens are displayed, all variables are initialized and the target data for the appropriate level (supported position) are moved to RAM. The main routine at subroutine 4510 is called in line 2530.

Lines 2540-2580: After the hit, miss, no fire, accuracy, and penalty summary screen is shown, the shot groups for all targets engaged are shown and records for the unsupported position are saved to disk if requested. If standards have not been met, control returns to line 2500.

Lines 2590-2730: The hit, miss, no fire, accuracy, and penalty summary screen is shown for both firing positions and the next level of fire is determined.

Lines 2740-2890: Firing level 9.

Lines 2740-2800: Instructional screens are displayed, all variables are initialized and the target data for level 9 are moved from EPROM to RAM. The high resolution graphics screen and status line are displayed.

Lines 2810-2890: The machine language routine controlling the target engagement and lightpen collection is entered. Due to the unique timing which is utilized in this level, all targets are displayed by this machine language routine, therefore, very little is done in BASIC. The positions are repeated (with shot groups and record storage to disk in between) until standards are met or the break key is pressed. After successful completion, the current level (CL) variable is set to 10 to signify the conclusion of the program and control is returned to line 280.

Lines 3000-3040: These lines perform the calculations for the diagnostic scores. For the steady position score, SD(0,S) is initially set to -1. Assume there are n readings. If n is greater than 45, SD(0,S) is set to examine the readings from -45 to -7. If n is less than 45 but greater than 6, SD(0,S) is set for readings n to -7. The range of readings for the aiming score is set to the same value as that of the steady position. For the trigger squeeze measure, SD(2,S) is set to -1. If there are more than 5 readings, it is changed so that readings -6 to -1 are examined. The machine language routine (MA) is then called to compute the scores.

Lines 3050-3060: Certain variables are saved into the array Ht.

Lines 3070-3080: Variables which were saved in lines 3050-3060 can be restored by calling this routine.

Lines 3090-3180: With the numeric diagnostic scores in the SD array, this routine returns the appropriate descriptive diagnostic score. It is most often called at line 3090, but in certain circumstances, may be called at line 3100 with the diagnostic score in 24 and the subscript for criterion comparison in 25. If the current level is 0 (zeroing procedure) and the NU variable (a flag for numeric scores) is not equal to 0, both the descriptive and numeric diagnostic scores are displayed simultaneously.

Lines 3190-3290: The ASSUME (proper) POSITION message is displayed. If PS is 0, the position is supported. For a 1 in PS, it is unsupported. If BS is not the null string, it is displayed above the ASSUME POSITION message. This routine is sometimes called at line 3250 to display the < PULL TRIGGER TO CONTINUE > message, at line 3260 to check for trigger pull, or at line 3280 to check for trigger release.

Line 3300: This procedure prints the string in A\$ to the graphics screen by calling the appropriate machine language routine.

Line 3310: The hires graphics screen at location S1 of chip/bank S2 is displayed.

Lines 3320-3350: The average diagnostic scores from B to E are computed.

Lines 3360-3410: Determines the appropriate next level of fire based on skill test performance.

Lines 3420-3480: These lines display the introductory screen to each level. If the trigger is pulled, the corresponding level is entered. If the break key is pressed, control is transferred to the menu screen.

Lines 3490-3930: The menu screen. This routine displays the options available to the user, including "L" (selecting start and stop levels), "N" (returns a new firer to the calibration routine), "W" (sets wind speed), "CS" (selects or deselects the "call your shot" option), "G" (returns to the level where the program was interrupted), and "EZ" (show only 250 meter targets on level 1).

Lines 3940-3970: Sprite initialization for the machine language replay routine.

Lines 3980-4290: Display diagnostic scores and replay for levels 1-4.

Lines 3980-4040: Display diagnostic scores. If a miss was detected, the word "MISS" is shown in place of a shot location score.

Lines 4050-4290: Show replay. The replay target is positioned so that its center of mass is at the point (254,176). The sight post which represents the perfect sight picture is adjusted for wind and trajectory. The replay message is displayed and the center of the screen is colored green by the machine language routine referenced by the variable CO. The replay is interrupt driven, and lines 4150-4170 wait for the replay to finish at least once before the trigger can be pulled. Lines 4200-4280 control the pause when the "Correct Sight Placement/Your Sight Placement" and "Pull trigger to continue" messages are displayed, waiting for either trigger pull, the break key, or the time limit to expire before showing the replay again.

Lines 4300-4450: Display final diagnostic scores for levels 1-4 and determine the next firing level.

Line 4300: If less than two shots have been fired, the summary scores are not displayed.

Lines 4310-4340: Compute the average diagnostic scores.

Lines 4350-4390: Display the final scores.

Lines 4400-4450: Determine the next firing level. If there is more than one poor score and the current level is greater than 1, the firer must regress a level. If there is a poor score or a score which is below

average, the firer must repeat the level. Otherwise, the firer attempts the next level.

Lines 4460-4510: A stack beginning at 16325 is used to store target numbers before the machine language routine referenced by the variable RM is called. By randomizing the numbers in the stack, the RM procedure can take the corresponding target from the data stored on the EPROM and place it in RAM. Before calling this subroutine, the variables B and E must be set to the beginning and ending point in the stack. This technique is used to accommodate those circumstances where two or more sets of targets must be randomized. For levels 5-8, the supported targets must be dealt with before the unsupported targets so that they are not all randomized together. This subroutine randomizes the stack so that the RM procedure can be called.

Lines 4520-4620: Main scenario routine for levels 5-8.

Lines 4520-4580: These lines perform the initialization process which varies for each level. The variable AD considers the different feedback for hit or miss (cross always, cross only for misses, or cross never) and whether or not the records should be saved to the disk buffer (remember that only the first attempt is saved).

Lines 4590-4610: The machine language target control routine is called, the whistle is blown if a target is left standing after the time limit has expired, and the procedure waits for the cross to disappear before continuing.

Line 4620: A random delay before the next screen is displayed.

Lines 4630-4690: Display shot groups. The target is positioned so that its center of mass is at (174,150) and the shots are displayed by the machine language routine referenced by the variable GP. The shot location score is returned in Z4. This result was once displayed at the bottom of the shot group screen.

Lines 4700-4850: Display the summary screen of hits, misses, no fires, shot location, and penalties for levels 5-8. It will also display the messages "Standard met" or "Standard not met."

Lines 4860-5050: Main scenario routine for levels 3-4.

Lines 4860-4920: All variables are initialized and the high resolution graphic screen with status line is displayed. The machine language routine which displays the targets is called.

Line 4930-4940: Hit, miss, or no fire is determined. If the break key was pressed or a no fire was recorded, the subroutine returns to line 2090.

Lines 4950-5050: The diagnostic scores are displayed and the replay is shown if a bad shot is determined. A bad shot is indicated by a poor score in any diagnostic measure or a below average or poor score for shot location.

Lines 5060-5150: Display diagnostic scores and shot group for the skill test.

Lines 5160-5240: Display summary screen for level 9.

Lines 5250-5270: Display four fundamentals of rifle marksmanship.

Lines 5520-5540: The "YOU DID NOT MEET THE STANDARD. PREPARE TO REFIRE." message is displayed and the border is changed to red to signify more target presentations due to a failure to meet standards.

Lines 5550-5560: The message "STANDARD MET. CONTINUE." is shown when a student has failed a standard, and then successfully meets a standard.

Lines 5570-5600: These lines display the status line after adding the current wind speed and direction.

Lines 5610-5680: This subroutine prompt the user for input at the menu screen. The menu is displayed on the high resolution graphic screen, necessitating a more complex means of obtaining the input. Only two characters or numbers are accepted.

Line 5690: The record keeping buffer is initially set for no fires.

Line 5700: This subroutine calls machine language routines from chip 0, bank 1. The variable SB should be set to the low byte of the address of the routine desired.

Line 5710: This routine performs the same function as in line 5700, except parameters can be passed through the variable Z.

Lines 5720-5730: The graphic depiction of the diagnostic scores ("bull's eye" target) and the target ranges are shown.

Lines 5740-5810: Displays examples of the proper offset for wind effects.

Lines 5820-5860: Checks the number of hits and determines if the firer was an expert, marksman, sharpshooter, or unqualified. If H%(0)=1, the firer had an earlier repetition and therefore can be rated only as high as sharpshooter.

Lines 6000-6120: Data.

APPENDIX G

MACS BRM Cartridge Program Listings

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10 POKR 808,237;V=53248;POKR 53281,0;POKR V+21,0;BS=-" :BL-1:BL-9:BS--1
20 DIM SD(3,25),CR(3,3),H(6,10),DA(6,10),CR(5)
30 I1=43640;I2=43964;HW=0;BS=0:CR=0
40 DEF FHW(X)=INT(X/256):DEF FHL(X)=INT(X/256)*256
50 DEF FHW(X)=PEEK(X)+PEEK(X+1)*256:DEF FHL(X)=INT((ABS(X>0)*X)+.5)
60 RK=256:EH=3460:DE=3403:RT=3406:EV=3409:BAHO=3415:SC=3421:HA=3424:LC=3430
70 GP=3433:CO=3436:WH=3439:RS=3442:DT=3445:T=0
80 IF PEEK(56321)=127 THEN BYS DS:QOSUB 3490:GOTO 130
90 IF PEEK(56321)=247 THEN QOSUB 3260:POKR 53280,0:SYS DS:GOTO 130
91 IF RK=256 THEN 100
92 T=7:2:IF T<800 THEN 100
93 IF (T AND 1)=1 THEN SYS 49188:T=0:GOTO 80
94 POKR 671,3:SYS RS:AS=" [LGRN]":QOSUB 3300:T=1:GOTO 80
100 GET A8:IF A8=" " THEN 80
110 BS=RIGHT8(B8,1)*A8:BS=-(BS="sg")*2:IF BS=0 THEN 80
120 SYS DS:POKR 53265,27:POKR 53272,23:PRINT7((CLR)"/":POKR 4*161,2:SYS 49178
130 IF RK=256 THEN 230
140 AS=(F3)09(F6)00(F5)00(F7)00(CL)F2)1302(F1)(GRN)H A C A(F2)0905(LBLU)Basic RIXle(F2)0002markmanship(F2)1211"
150 AS=A8+"Training(MED)F3)00":QOSUB 3300
160 POKR 53281,0:FOR I=0 TO 9:FOR J=0 TO 3:READ CR(I,J):NEXT J,I
170 FOR I=1 TO 6:FOR J=0 TO 4:READ DA(I,J):NEXT J,I
180 FOR I=1 TO 5:READ CR8(I):NEXT I
190 REM 2=0:BS=15:QOSUB 3710:RK=2
200 RK=0:FOR I=1 TO 500:NEXT I:IF RK=0 THEN 230
210 POKR 53265,27:POKR 53272,23:INPUT7((CLR)Data":A8:IO=LEFT8(A8,8)+CHR8(13)
220 INPUT7Unit":A8:IO=108+LEFT8(A8,20)+CHR8(13)
230 POKR 914,0:BL=0:CL=0:RS=8":QOSUB 1000:IF CL>BL THEN CL=BL
240 IF CL<BL THEN CL=BL
250 QOSUB 3420:BC=BL:IF CL=0 THEN 230
260 IF (W AND 16) THEN WI=INT(RND(1)*5):WI=16+((WI-(WI=4)*2))+INT(RND(1)*8)*32
270 POKR 914,WI:ON CL QOSUB 1650,1650,1940,1940,2310,2310,2310,2310,2740
280 MO8="a":IF (CL<=BL) AND (BL>=EL) THEN 240
290 AS=(F3)09(F6)05(CL)F5)05(F7)05(BLK)(F2)0504(F1)CONGRATULATIONS(F2) (F1) You are finished(F2) with this "
300 AS=A8+"program.(F8) Call instructor.(F1)":QOSUB 3300
310 POKR 53280,0:SYS 49188:RESTORE:POKR 198,0:GOTO 80
320 TM=0:HS(0)=0:BS=32768:BS=0:IF RK=0 THEN 1020
330 POKR 53272,23:POKR 53265,27:INPUT7((CLR)Firex ID 4":IDS:IDS=LEFT8(IDS,20)
340 QOSUB 5250:POKR 53265,43:AS=(F6)00(F5)13(F7)00(CL)(F1)(F2)0701First 3 shots"
350 AS=A8+"(F2)0003establish shot group(F2)0105Aim center of mass."
360 AS=A8+"(F2)0317white dot show(F2)1319center.":QOSUB 3300
370 POKR 880,3:SYS DS:FOR S=12196 TO 12199:POKR 2,15:NEXT S:POKR 1524,1
380 AS=(F2)0723:FULL trigger to continue>(F3)00":QOSUB 3300
390 IF PEEK(56321)=247 THEN 1100
400 GET A8:IF A8>" " THEN 1070
410 TH=1
420 QOSUB 3280:IF WI=0 THEN 1130
430 AS=(F3)09(F5)00(F7)00(F1)(GRN)(F2)0904There is no(F2)0607wind while you(F2)0610are establishing"
440 AS=A8+"(F2)0813shot group. (LGRN)(F1)":QOSUB 3300
450 BC=0:POKR 889,42:POKR 883,60:POKR 888,0:FOR S=834 TO 837:POKR S,0:NEXT S
460 OX=0:CY=0:POKR 889,0:POKR 889,160:POKR 891,40:POKR 892,160
470 POKR 823,0:POKR 824,0:POKR 821,17:POKR 822,0:BS=6:QOSUB 5700:S=0
480 IF (S>0) AND (A8>3) THEN 1210
490 FOR S=0 TO 3:SD(S,25)=0:NEXT S:PS=INT(S/3)
500 BS=(F1)(F2)0303(GRN)Next 3 shots help(F2)0106decide start level.":IF PS THEN 1200
510 BS=(F1)(F2)0301(GRN)Fire one shot per(F2)1304target.(F2)0007targets are untimed."
520 QOSUB 3190:QOSUB 3310
530 POKR 876,0:POKR 877,205:X=((INT(RND(1)*75))*2)+71:IF TM THEN X=165
540 POKR 52481,X:QOSUB 3290
550 S=-20352:BS=0:QOSUB 3710:POKR V+21,0:IF S=128 THEN 1210
560 W=FHW(907):W=H+(H>128)*(H-128):QOSUB 3000
570 IF S>2 THEN 1200
580 X1=(X+11):FHW(847):Y1=165-FHW(849):OX=OX+X1:CY=CY+Y1:SD(1,S)=Z
590 IF (X1>75) OR (X1<148) OR (Y1>17) OR (Y1<47) THEN BC=1
600 SD(0,25)=SD(0,25)*SD(0,S):SD(2,25)=SD(2,25)*SD(2,S)
610 QOSUB 3280:IF S>2 THEN 1450
620 OX=INT((OX/3)+1):OX=INT((OX/2)*2:CY=INT((CY/3)+0.5)
630 IF (BC=0) OR (EG=0) THEN 1370
640 AS=(F3)09(CL)(RED)(F5)00(F7)00(F1)(F2)0204Invalid shot group(F2)1107try again":IF HW(0)=0 THEN 1340
650 AS=A8+"(F2)0310or check lightpen(F2)053mount alignment(F2)0416(see manual)"
660 AS=A8+"(F1)(LGRN)":HS(0)=1:QOSUB 3250
670 IF BR THEN S=1:GOTO 120
680 GOTO 1130
690 X=OX-(OX<0)*65536:Y=CY-(CY<0)*65536
700 POKR 838,FHL(X):POKR 838,FHW(X):POKR 838,FHL(Y):POKR 837,FHW(Y)
710 SD(1,0)=SD(1,0):BS=3427:FOR S=0 TO 3:SD(1,S)=SD(1,25)+SD(1,S)
720 SD(3,25)=SD(3,25)*SD(3,S):NEXT S:S=43840:QOSUB 5060
730 AS=(F3)08(CL)(F5)00(F7)00(F1)(WHT)shot group"+CR8+"(LBLU)(F2)0304Would you like to(F2)1107try for a"
740 AS=A8+"(F2)0610lighter group?(F1)(F2)0523(GRN)full trigger to select answer(F2)0017(F3)08"
750 QOSUB 3300:BS=16:QOSUB 1710:POKR 53265,43:IF S=8 THEN 1130
760 BS=0:BS=2:QOSUB 3370:S=2:IF (E=0) OR (EL>2) THEN CL=3:RETURN
770 S=8:1:IF S<6 THEN 1160
780 POKR 53265,43:FOR S=3 TO 5:SD(1,25)=SD(1,25)+SD(1,S)
790 SD(3,25)=SD(3,25)*SD(3,S):NEXT S:S=43664:QOSUB 5060
800 S=6:7=0
810 S=3:BS=5:QOSUB 3370,IP (E=0) OR (EL<3) THEN CL=2:RETURN
820 BS=0:(F1)(F2)0101(GRN)you have done well!(F2)1304Now try(F2)0607timed targets."
830 POKR 838,0:POKR 889,0:POKR 890,160:POKR 891,40:POKR 892,160:POKR 876,0
840 POKR 877,205:POKR 823,17:POKR 824,0:POKR 821,114:POKR 822,0:BS=6:QOSUB 5700
850 FOR S=8 TO E
860 BS=0:S=20352:QOSUB 3710:POKR V+21,0

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1570 IF E>63 THEN SYS WH:FOR E=0 TO 3:BD(E,E)=CR(E+PB*4,3):NEXT E:GOTO 1590
1580 E=PBW(907):H=H+(H>128)*(H-128):GOSUB 3000
1590 GOSUB 3260:NEXT S:GOSUB 3370:IF (E>0) AND (EL>(T+2)) THEN 1610
1600 H=6:CL=T+2:BD="":GOTO 1630
1610 T=T+1:IF T>2 THEN BD=1:BD="":GOSUB 3190:GOSUB 3310:BD=3:BD=5:GOTO 1830
1620 H=6:CL=5:BD="":F2)1005W011 done!""
1630 A8=""(F3)09(CLR)(F3)00(F7)00(GRW)(F1)"&BD+"(F2)0308You will start at(F2)1511. . .(F3)00"
1640 GOSUB 3200:FOR D=1 TO 800:HLT D:RETURN
1650 GOSUB 3720:GOSUB 3740:HT=3:PB=CL-1:BD="":F1)(F2)0002(GRW)Targets are untimed."
1660 BD=BD+"(F2)0003Standard: Hit 2 of 2(F2)0308at each distance.":GOSUB 3190
1670 GOSUB 3690:POKE 876,0:POKE 877,205:POKE 889,0
1680 POKE 890,160:TH=0:POKE 891,40:POKE 892,180:POKE 838,0:POKE 899,42
1690 IF (BD=0) OR (CL>1) THEN 1720
1700 FOR E=0 TO HT*6-1:POKE 16325+E,6:NEXT E:POKE 16325+HT*6,255
1710 POKE 821,0:POKE 823,114:POKE 824,0:BD=3:GOSUB 3700:GOTO 1730
1720 POKE 823,114:POKE 824,0:POKE 821,235:POKE 822,0:BD=6:GOSUB 3700
1730 BD=32768:BD=8:IR=-32640-(C8*4096):H=0:TH=TH+1:RF=0:IP TH=7 THEN 1930
1740 GOSUB 3050
1750 S=PEER(838):GOSUB 3310:AB="L"+*8TR8(CL):"T"+*8TR8(B+1)+"R"+*8TR8(RP)
1760 GOSUB 3570:POKE I2+7*8,0,RP:IX=-(HT*(RD((I)+65))+2)+71:AD=PBW(876)
1770 POKE AD+1,X=PEER(AD+2):POKE AD+6,235:TJ=PEER(AD+11):TJ=TJ+(TJ*127)*256
1780 IF (TH=1) AND ((BD=0) OR (CL>1)) THEN POKE AD+15,X=40:POKE AD+20,235
1790 GOSUB 3950:BD=0:IR=GOSUB 3710:POKE 878,0:IF E=128 THEN 1930
1800 IF CB=0 THEN 1830
1810 A8=""(F2)0423(BLK)(BLK)(F1)Call your shot!:E1=TJ*359
1820 E2=INT((E1-TJ)/60):A8=A8+"(F2)3423"+8TR8(E2):GOSUB 3300:A8="":F1)"
1830 IF BD>0 THEN 1820
1840 POKE V+21,PEER(V+21):OR 1
1850 A8=""(BLK)(F1)(F2)0423 (F2)0123"+CRW(142)
1860 BD="miss":IF PEER(900)<128 THEN H=H+1:BD="hit"
1870 A8=A8+BD:GOSUB 3300:GOSUB 3960:IF E=128 THEN 1930
1880 BD=8+1:IF E/3>INT(E/3) THEN POKE 876,86(2):POKE 877,88(3):GOTO 1730
1890 BD=3:Z=11+H((1)*8):GOSUB 4630:IF H<2 THEN 1920
1900 IF RF>0 THEN BC=BL:GOSUB 3590
1910 GOTO 1730
1920 GOSUB 3070:IR=-31616-(C8*4096):RP=RP+1:H=0:GOSUB 5520:GOTO 1730
1930 POKE V+21,0:GOSUB 4300:CL=CL/A:RETURN
1940 RF=0:PB=CL-3:BD=4:GOSUB 3740
1950 A8=""(F3)09(F6)00(CLR)(F5)00(F7)00(GRW)(F1)(F2)030324 timed target,ets.":IF CL=4 THEN 1980
1960 A8=AB+"(F2)0007Standard: Hit 3 of 4(F2)0310at each distance."
1970 A8=AB+"(F2)0614Replay for bad(F2)0917shots only.(F1)(GRW)":GOSUB 3250:BD="":GOTO 2010
1980 A8=AB+"(F2)11078Standard:(F2)0010Hit 3 of 4 at ranges(F2)0012between 50 and 200 m"
1990 A8=AB+"(F2)0715Hit 2 of 4 at(F2)0717250 and 300 m(F1)(GRW)":GOSUB 3250
2000 BD=0:(F1)(GRW)(F2)0604Replay for bad(F2)0907shots only."
2010 GOSUB 3190:POKE 53265,43:GOSUB 5690:IR=-32640:POKE 899,42
2020 BD=0:Z=HT*6-1:GOSUB 4460
2030 AD=21:FOR E=1 TO HT*6:POKE AD,235:AD=AD+8:NEXT E:BD=3:HT=37445:BD=8
2040 FOR E=0 TO E:POKE 16325+E,HT:INT(PEER(16325+E)/HT):NEXT E:FOR E=1 TO 6
2050 DA(E,5)=0:DA(E,6)=0:NEXT E:FOR E=11 TO 14:199 STEP 8:POKE E,0:NEXT E
2060 POKE 821,0:POKE 823,114:POKE 824,0:BD=3:GOSUB 3700:POKE 876,0:POKE 877,205
2070 I=0:GOSUB 3310
2080 I=I+1:IF INT(E THEN 2120
2090 GOSUB 4860:POKE V+21,0:IF E=128 THEN 2230
2100 IF E=64 THEN SYS WH
2110 GOTO 2080
2120 FOR TH=1 TO 6:E=I1+(TH-1)*32:N=4:GOSUB 4630:NEXT TH:Y=-1
2130 POKE 53265,43:RP=RP+1:ER=0:TH=1
2140 IF DA(E,1)>=(3*((CL=4) AND (TH>4))) THEN 2230
2150 ER=1:IR=-31616:POKE 821,0:POKE 823,114:POKE 824,0:IF F THEN GOSUB 5520
2160 AD=I1+(TH-1)*32:FOR Z=1 TO 6:POKE AD,235:AD=AD+8:NEXT E
2170 FOR E=0 TO HT-1:POKE 16325+E,TH-1:NEXT E:POKE 16325+HT,235:BD=3:GOSUB 3700
2180 POKE 876,0:POKE 877,205:DA(E,TH,5)=0:DA(E,TH,6)=0:GOSUB 3310
2190 GOSUB 4860:POKE V+21,0:IF E=128 THEN 2230
2200 IF E=64 THEN SYS WH
2210 I=I+(TH-1):Y=DA(E,TH,6):INT THEN 2190
2220 E=I1+(TH-1)*32:N=4:GOSUB 4630:F=0
2230 TH=TH+1:IF TH>7 THEN 2140
2240 IF ER THEN 2130
2250 POKE V+21,0:FOR J=0 TO 3:BD(J,25)=0:NEXT J
2260 H=0:FOR TH=1 TO 6:IF DA(E,TH,6)=0 THEN 2290
2270 FOR I=1 TO DA(E,TH,6):E=(TH-1)*M+I:(I-1):M=M+
2280 FOR J=0 TO 3:BD(J,25)=BD(J,25)+BD(J,8):NEXT J,I
2290 NEXT TH:=-0:BL=0:IF H>0 THEN GOSUB 4330
2300 CL=CL/A:RETURN
2310 GOSUB 3740:A8=""(F3)09(F6)00(CLR)(F5)00(F7)00(GRW)(F1)(F2)040240 timed targets(F2)0205Randomly presented"
2320 A8=AB+"(F2)0308single or double.(F2)021220 shots/supported"
2330 A8=AB+"(F2)001520 shots/unsupported(F1)(GRW)":GOSUB 3250
2340 PB=0:BD="":F1)(GRW)(F2)0502Fire at closest(F2)0404targets first or"
2350 BD=BD+"(F2)0005penalty is recorded.(F2)0108Standard: 15 of 20.":GOSUB 3190
2360 GOSUB 5690:RP=0:IR=512
2370 H(0)=0:BD=35050:BD=2:IF CL>7 THEN BD=37968:BD=2
2380 POKE 33265,43:BD=15:GOSUB 4460:POKE 876,0:POKE 877,205:POKE 899,0
2390 POKE 890,160:POKE 891,40:POKE 892,180:POKE 838,0:POKE 899,20:POKE 910,0
2400 POKE 918,0:POKE 919,0
2410 POKE 912,0:TH=0:POKE 821,0:POKE 823,235:POKE 824,0:BD=3:GOSUB 3700
2420 GOSUB 4520:A=2:POKE I2+7,RP:HI=0:W=PEER(838):IF (H=0) AND (A>128) THEN 2460
2430 A8=""(F3)09(F6)00(CLR)(F5)00(F7)00(LBLU)(F2)0601SUMMARY: Supported Position":GOSUB 4700
2440 HI=21:MI=12:HT=83:AC=84:IF A>128 THEN BL=0:RETURN
2450 FOR TH=1 TO 6:I=11:GOSUB 4630:NEXT TH
2460 IF H<15 THEN IR=1936:RP=RP+1:H(0)=1:GOSUB 5520:GOTO 2380
2470 S4=AC:BC=BL
2480 PB=PEER(912):TH=16:RP=0:PB=1:BD="":F1)(GRW)(F2)1048Standard:(F2)0707Hit 15 of 20."
2490 GOSUB 3190:POKE 899,40:POKE 53265,43:IR=512
2500 BD=16:BD=28:GOSUB 4460:POKE 876,0:POKE 877,205:POKE 899,176:POKE 890,164
2510 POKE 891,184:POKE 892,181:POKE 838,20:POKE 910,0:POKE 912,0
2520 POKE 918,2:POKE 919,0
2530 POKE 821,16:POKE 823,235:POKE 824,0:BD=3:GOSUB 5700:GOSUB 4520:A=2
2540 POKE 12*167,RP:HI=0:W=PEER(820):20:IF (H=0) AND (A>128) THEN 2580
2550 A8=""(F3)09(F6)00(CLR)(F5)00(F7)00(LBLU)(F2)0501SUMMARY: Unsupported Position":GOSUB 4700

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2360 HI>21:MI>22:MF>83:IF A=128 THEN BL=0:RETURN
2370 A=84:FOR TH=1 TO 6:8-11:160:GOSUB 4630:NEXT TH
2380 IF HI<13 THEN IR=1536:RF=RF1:HI=0:1:GOSUB 5320:TH=16:GOTO 2390
2390 FOR V>21,0:84=A:AC=(AC/24)/2
2400 HI>0:MI>0:MF>8-[F3]09:[F6]00([CLR])(F3)00([F7]00([CLR])(GCR)Start level="2400
2410 A8=A8*([F2]1303)(GCR)(HI)([F2]1399)(RED)MI&ss([YLELO])(F2)1399(GCR)">STR8(E)
2420 FOR I=1 TO 6:2=DA8(1,5)+DA8(1,8):A8="([LBLU])(F2)0599*STR8(I*50)*([F2]1399(GCR)">STR8(E)
2430 HI>HI*2:2=DA8(1,6)+DA8(1,9):A8=A8*([F2]2299)(RED)">STR8(E)(HI>I*2
2440 3=DA8(1,7)+DA8(1,10):A8=A8*([F2]3299)(YLELO)">STR8(3)">([F6])(F8)">MF>2:GOSUB 3300:NEXT 3
2450 A8="([F2]0699([LBLU])TOTAL([F2]1399(GCR)">STR8(HI)">([F2]2299)(RED)">STR8(MI)">([F2]3299)(YLELO)">STR8(MF)
2460 24=AC135-9:GOSUB 3100:A8=A8*([F6])(F8)(LBLU)(F2)0699Penalties;">
2470 A8=A8*STR8(PER(B12)+PM)+*[F6]([F2]0699)overall shot location;">
2480 A8=A8*RIGHTS(CRM,LEN(CRM)-5)">([F6])(F8)(F2)0699)overall shot location;">GOSUB 3230
2490 IP (B>2) ON (HI>35) THEN BL=0:CL=CL+1:RETURN
2500 IP S=1 THEN AC=(CL>BL):BL=6-A:CL=CL-A:B8="([F2]1599)poor.">GOTO 2720
2510 BL=6:B8="([F2]0699)below average."
2520 A8="([F3]09([CLR])(RED)(F1)(F8) You are being sent([F8])(C/R/T) back to level">STR8(CL)">([F6])(F2)0699because"
2530 A8=A8" your([F8])(F2)0699shot location was([F8])>B8+[F1](GCR)">GOSUB 3250:RETURN
2540 PB=0:GOSUB5740:BD(0,0)=0:BD(1,0)=0
2550 B8="([F1])(GCR)(F2)060246 target([F2]0603Attack/Retreat([F2])1108scenario.">GOSUB 3190
2560 FOR S=0:R8=0:S8=37968-52-2:GOSUB 3650:IR=4736:I8=0
2570 FOR 876,0:POKE 877,203:POKE 889,0:POKE 890,160
2580 TH=0:POKE 891,40:POKE 892,180:POKE 838,0:POKE 889,40:POKE 912,0
2590 POKE 823,145:POKE 824,3:POKE 821,59:POKE 822,6:BD=6:GOSUB 5700
2600 POKE 8310:A8="([F6]91)*([F6]00([CLR])(F5)00([F7]00([LBLU])(F2)0601SUBARY;">B8:MF=PEEK(838):GOSUB 5710:POKE 918,0:POKE 919,0
2610 POKE 12+7,RF:BB=0:IR:GOSUB 5710:A8=3
2620 POKE V>21,0:POKE 83280,0:MF=PEEK(838):IF M=0 THEN RETURN
2630 B8="Supported Position" IF PB THEN B8="Unsupported Position"
2640 A8="([F3]09([F6]00([CLR])(F5)00([F7]00([LBLU])(F2)0601SUBARY;">B8:MF=PEEK(838):GOSUB 5160
2650 IP A=128 THEN BL=0:RETURN
2660 FOR TH=1 TO 6:11:GOSUB 4630:NEXT TH
2670 IF HI<23 THEN IR=3712:RF=RF1:HI=0:1:GOSUB 5520:GOTO 2770
2675 SD(0,0)=SD(0,0)+HI:SD(1,0)=SD(1,0)+1
2680 BC=BL:RF=0:IF PB=0 THEN PB=1:B8="([F2]0603Attack/Retreat([F2])1108scenario.">GOSUB 3190
2690 CL=10:24+SD(1,0)/2:BB=9:GOSUB 3100:POKE 786,FNL(HS):POKE 786,FNH(HS)
2700 SD(0,0)=SD(0,0)+(2/10)-(1-(WI AND 96)=6)-(WI AND 32)*5)-(WI AND 7)
2710 POKE 871,1:2=USR(SD(0,0)):IF PEER(924)>10 THEN RETURN
2720 POKE 871,0:SYS MS:POKE 871,212=USR(SD(0,0)):RETURN
3000 SD(0,8)=1:IF M>6 THEN SD(0,8)=(M-6)*256+(M-7):IF M<45 THEN SD(0,8)=M-7
3010 SD(1,8)=SD(0,8)
3020 SD(2,8)=11:IF M>5 THEN SD(2,8)=(M-6)*256+(M-1)
3030 POKE 785,FNL(MA):POKE 786,FNH(MA):B=USR(B)
3040 RETURN
3050 HI(1)=PEEK(838):HI(2)=PEEK(876):HI(3)=PEEK(877):HI(4)=PEEK(889)
3060 HI(5)=PEEK(890):HI(6)=PEEK(891):HI(7)=PEEK(892):HI(8)=PEEK(899):RETURN
3070 POKE 838,HI(1):POKE 876,HI(2):POKE 877,HI(3):POKE 889,HI(4)
3080 POKE 890,HI(5):POKE 891,HI(6):POKE 892,HI(7):POKE 899,HI(8):RETURN
3090 Z=SD(J,8):Z=Z*PS*4
3100 Z=5:IF Z>CR(25,0) THEN Z=4
3110 IF Z>CR(25,1) THEN Z=3
3120 IF Z>CR(25,2) THEN Z=2
3130 IF (Z>CR(25,3))OR(Z<0) THEN Z=1
3140 CR8=CR8(Z):IF (CL>0) OR (MU=0) THEN RETURN
3150 B8=STR8(39-LEN(STR8(B8))):B8=RIGHT8(B8,2)
3160 CR8="([F1])(F2)2499*MI&ss([F8]([F2]2499*MI&ss([F8]([F2]2499*MI&ss([F8]([F1])(F8))>RETURN
3170 B8=STR8(B8)24-LEN(B8))IF Z<4 THEN FOR Z=1 TO 4-Z:BB=" "+B8:NEXT Z
3180 CR8="([F1])(F2)2499*MI&ss([F8]([F2]3599*BB+[F1])(F8))>RETURN
3190 POKE V>21,0:A8="([F3]09([CLR])(F6)00([F5]00:[F5]00:IF B8=" " THEN A8=A8*([FHT)(F1)(F2)0008":B8="([F6])(F8)">GOTO3210
3200 A8=A8*BB:GOSUB 3300:A8="([F1])(WHT)(F2)0012":B8="([F6])(F1)(F8)(F1)"
3210 IF PB THEN A8=A8*([F2]1199)ASUME JN=BB+[F2]0999UN":GOSUB 3230
3220 A8=A8*([F2]12999ASUME A"=BB+[F2]1199"
3230 A8=A8*8"SUPPORTED":B8="([F2]12999POSITION"
3240 A8=A8*"8"([F1]">B8+[F1](GCR)(F2)0023<Pull trigger to begin>([F3]00":GOSUB 3300:GOTO 3260
3250 A8=A8*"8"([F2]0723<Pull trigger to continue>([F3]00":GOSUB 3300
3260 BR=0:IF PEER(56321)=127 THEN BR=1:GOTO 3280
3270 IF PEER(56321)>>247 THEN 3260
3280 IF PEER(56321)>>255 THEN 3280
3290 RETURN
3300 A8=A8*SYS 49182:RETURN
3310 FOR 253,FNL(S1):POKE 254,FNH(S1):POKE 251,82:BY8 SC:RETURN
3320 REA GET AVERAGE ACROSS B-E SHOTS FOR EACH DIAGNOSTIC SCORE
3330 FOR Z=0 TO 3:BD(Z,12)=0:NEXT Z
3340 FOR Z1=0 TO 3:FOR Z2=0 TO 8:SD(Z1,12)=SD(Z1,12)+SD(Z1,12):NEXT Z2,Z1
3350 Z=(E-B)+1:FOR Z2=0 TO 3:SD(Z2,12)=SD(Z2,12)/Z:NEXT Z2:RETURN
3360 REA ROUTINE TO SEE IF SHOTS B-E FALL INTO RANGE FOR ADVANCEMENT
3370 FOR J=1 TO S:HI(J)=0:NEXT J:GOSUB 3330
3380 IF (HI(1)>0) OR (HI(2)>0) OR (HI(3)>0) OR (HI(4)>0) THEN Z=0:RETURN
3390 I=1:RETURN
3400 A8="([F3]09([F6]00([CLR])(F5)00([F7]00([F1)(LBLU)(F2)1305LEVEL([F2]1709":B8=STR8(CL)
3410 A8=A8*BB+[F1](F2)0019":GOSUB 3300:POKE 823,CL=BD-21:GOSUB 5700
3420 A8="([F1])(F2)0723<Pull trigger to continue>([F3]00":GOSUB 3300
3430 IF PEER(56321)=247 THEN RETURN
3440 IF PEER(56321)<>127 THEN 3450
3450 GOSUB 3490:IF CL=0 THEN RETURN
3460 GOTO 3420
3470 FOR 53265,0:POKE 53272,31:POKE 198,0:A8="([F6]00([F7]00([CLR])(GCR)Start level="3470
3480 A8=A8*STR8(BL)+"(QRY1)(F2)1399AR18902(GCR)Final level:">STR8(BL)+"([F6])(LBLU)Wind speed: "
3490 IY (WI AND 16) THEN A8=A8* " Variable":,GOTO 3540
3500 A8=A8*STR8((WI AND 7)*3)+" WPH ":"IF ((WI AND 7)=0) THEN 3540
3510 B8=STR8((INT(WI/32)+1):B8=" "+RIGHT8(B8,3):A8=A8*"8B8
3520 A8=AS*"8(BL)(F8)":GOSUB 3300:POKE 252,81:POKE 254,81:POKE 823,0:BB=21:GOSUB 5700
3530 Z=154-(BL>1) OR (BL>8)*4:AA=CH8(S1:"[F8] L: Select Start/Final Level/[F8](LBLU)"
3540 B8="([LBLU)":IF (WI AND 23) THEN ZB="([YLELO)"
3555 A8=A8* " B: Net Filter([F8]">B8" B: Set Wind Speed([F8)"
3560 B8="on ">B8="([LBLU)":IF C8 THEN B8="off "I8="([YLELO)"
3570 A8=A8*28*"8C8: Turn ">B8=CH8(34)+"Call your shot">CH8(34)+" option([F8)(LBLU)"
3580 A8=A8*"8LP: Light pen mount adjustment([F8)SG: Sighting and grouping program([F8)"
3590 GOSUB 3300:B8="250 meters":BB="([LBLU)":IF E1 THEN BB="all ranges":I8="([YLELO)"

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3600 A8->"RS: Set level 1 targets for "+BS+"(P8)(LBLU)"
3610 BS->"start":IF CL<0 THEN BS->"level":STR8(CL)
3620 A8->BS+" CL Go to "+BS:BS->"number or letter":IF CL=0 THEN BS->"letter"
3630 A8->BS+(P2)0023(RD)BS->"BS+ & press RETURN(LBLU)(P8)(P3)00":GOSUB 3300
3640 A8-":":GOSUB 3610:BS-INT(VAL(A8))
3650 IP A8->"SL1 AND (CL<=EL) AND (CL>0) THEN CL-2:N8-":":BL-0:RETURN
3660 IP A8->"NU" THEN NU-NOT(NU):GOTO 3490
3670 IP A8->"E1" THEN E1-NOT(E1):GOTO 3490
3680 IP A8->"CS" THEN CS-NOT(CS):GOTO 3490
3685 IP A8->"EG" THEN EG-NOT(EG):GOTO 3490
3690 IP A8->"N" THEN CL-0:RETURN
3700 IP A8->"O" THEN RETURN
3710 IP A8->"L" THEN 3800
3720 P02->"BS+(P2)0723(RD)number & press RETURN" (P2)0024(BLUE)start level (1-9)"
3730 GOSUB 3610:BS-INT(VAL(A8)):IF (SL<1) OR (SL>9) THEN 3720
3740 IP (CL<SL) AND (CL>0) THEN CL-EL
3750 IP SL-0 THEN SL-9:GOTO 3490
3760 A8->"VV2)0024(LBLU)Final level ("+BS+"-9)":GOSUB 3610:BL-INT(VAL(A8))
3770 IP (BL<SL) OR (BL>9) THEN 3760
3780 IP CL>EL THEN CL-EL
3790 GOTO 3490
3800 IP A8->"W" THEN 3920
3810 A8->"(P3)09(CLR)Wind Effects:(P8)(P8)Type a number (1-3) for wind speed:(P8)(P8)"
3820 A8->BS+" 1: 0 MPH(P8)(P8) 2: 10 MPH(P8)(P8) 3: 20 MPH(P8)(P8) 00":GOSUB 3300
3830 A8-":":GOSUB 3610:BS-INT(VAL(A8)):IF (W1<1) OR (W1>3) THEN 3830
3840 W1-(W1-1):2:IF W1=4 THEN W1-16:GOTO 3490
3850 IP W1=0 THEN 3490
3860 A8->"(P3)09(CLR)Wind Effects:(P8)(P8)Type a number (1-8) for wind direction:(P8)(P8)"
3870 A8->BS+" 1: (P4)01 (No value)(P8)(P8) 2: (P4)02 (Half value)(P8)(P8) 3: (P4)03 (full value)(P8)(P8)-
3880 A8->BS+" 4: (P4)04 (Half value)(P8)(P8) 5: (P4)05 (No value)(P8)(P8) 6: (P4)06 (Half value)(P8)(P8)-
3890 A8->BS+" 7: (P4)07 (Full value)(P8)(P8) 8: (P4)08 (Half value)(P8)(P8) 00":GOSUB 3300
3900 A8-":":GOSUB 3610:IP (VAL(A8)<1) OR (VAL(A8)>8) THEN 3900
3910 W1-W1+(1(VAL(A8)-1)+32):GOTO 3490
3920 E--(A8->"LP")-(A8->"EG")*2:IF E>0 THEN 120
3930 GOTO 3640
3940 REM SETUP FOR REPLAY: CALL ONCE BEFORE ANY TARGETS PRESENTED
3950 POK2 2041,43:POKE 2042,43:POKE 2043,43:POKE 2044,43:POKEV+23,6:POKE V+29,6
3960 POK2 V+40,1:POKE V+41,0:POKE V+42,0:POKE V+43,1:POKE V+44,6:POKE V+7,164
3970 POK2 V+8,126:POKE V+9,164:RETURN
3980 N-FNN(907):N-W-(N>128)*(N-128):GOSUB 3000:HI=PERK(900)<128
3990 J-0:GOSUB 3090:BS->"(P3)05(CLR)(P5)00(F1)(WHT)steady pos"+CR8:XI-2:BS-MID8(CR8,6,2)
4000 J-1:GOSUB 3090:A8-A8-(WHT)aiming":S18-CR8:XI2-X2
4010 CR8->"(P2)3098"+BS+"check":IF XI>2 THEN CR8->"(P2)3699"+BS+"ok"
4020 BS->"(WHT)breath con"+CR8
4030 J-2:GOSUB 3090:BS-B8-(WHT)trigger sq"+CR8:GOSUB 3280
4040 J-3:GOSUB 3090:BS-B8-(WHT)trigger sq"+CR8:GOSUB 3280
4044 IP (X1>3)AND(X2>3)AND(Y1>3)AND(H1=0) THEN S18-CR8:XI2-X2:SD(1,8)=CR(1+P8*4,2)
4045 CR8->"(P1)(P2)0008(LBLU)shot loc"+CR8:A8-A8+S18+B8
4050 E-TN-(#32767):E5536:IF (CL=1) AND (E2) THEN E-5
4060 POK2 839,X+DA8(2,2):POKE 840,0:POKE 841,Y+DA8(2,3)
4070 POK2 V+4,231-W:POKE V+5,175-TJ
4080 XI-ABS(244-(FNN(847)-(X+DA8(2,2))):Y1-ABS(191+(PERK/849)-(Y+DA8(2,3)))
4090 XI2-PERK(V+16) AND 230:IF FNN(X1)<0 THEN XI2-X2 OR 1
4100 GOSUB 3300:POKE V,FNN(X1):POKE V+1,FNN(Y1):POKE V+16,X2
4110 WS-128:POKE V+14,254-DA8(2,2):POKE V+15,200-DA8(2,3)
4120 IP (TN=1) AND (E2=0) OR (CL<1) THEN WS-192:POKE V+12,255:POKE V+13,166
4130 POK2 823,0:POKE 824,17:POKE 253,221,SY8 CO:POKE2 845,1,F-1,SY8 SY
4140 POK2 V+21,WS OR 6:A8->"(BLK)(P2)0217(F1)(WVN)replay(RVDF)(P3)00":GOSUB 3300:N-FNN(915)
4150 N-W-(N>255)*(N-255):POKE 821,N-W-N-60:POKE 833,-W(N>0):POKE 884,1
4160 IF (PERK(804) AND 1)=0 THEN 4190
4170 IF (PERK(56321)=247) AND (F=0) THEN POK2 884,0:Z-0:GOTO 4290
4180 GOTO 4160
4190 BY8 BANG:F-0:POKE V+21,WS OR 31
4200 A8->"(BLK)(P2)0217correct your (P8) sight sight(P8) placement placement"+CR8
4210 POK2 823,0:POKE 824,2:POKE 253,0:BY8 CO:GOSUB 3300:F-1:Z-1
4220 IF PERK(56321)=247 THEN Z-0:GOTO 4290
4230 IF PERK(56321)=127 THEN Z-128:GOTO 4290
4240 Z-2-1:IF Z<10 THEN 4220
4250 F-F+1:IF F>2 THEN 4280
4260 A8->"(BLK)(P2)0017 pull trigger (P8) to continue" (P8)
4270 GOSUB 3300:POKE V+21,WS OR 1:Z-0:GOTO 4220
4280 F-0:POKE 823,8:POKE 824,2:POKE 253,221:BY8 CO:GOTO 4140
4290 GOSUB 2280:POKE V+21,0:RETURN
4300 A=0:BL=0:(N=PERK(838)):IF N<0 THEN RETURN
4310 FOR J=0 TO 3:SD(J,25)=0:NEXT J
4320 FOR S=0 TO N-1:FOR J=0 TO 3:SD(J,25)=SD(J,25)+SD(J,S):NEXT J,S
4330 FOR J=1 TO S:SD(J,J)=0:NEXT J
4340 FOR J=0 TO 3:SD(J,25)=INT((SD(J,25)/N)+.5):NEXT J,S:SD(J,25)=J-0:GOSUB 3090
4350 A8->"(P3)05(P5)00(F1)(CLR)(LBLU)(P2)0400(F1)summary: level"+STR8(CL)+"(P8)(P8)(WHT)steady pos"+CR8
4355 H0(Z)-H0(Z)+1:XI-S18-MID8(CR8,6,1)
4360 J-1:GOSUB 3090:A8-A8-(P8)(WHT)aiming":CR8:H0(Z)-H0(Z)+1
4361 CR8->"(P2)3098"+BS+"check":IF XI>2 THEN CR8->"(P2)3699"+BS+"ok"
4366 A8-A8->"(P8)(WHT)breath con"+CR8
4370 J-2:GOSUB 3090:A8-A8-(P8)(WHT)trigger sq"+CR8:H0(Z)-H0(Z)+1
4380 J-3:GOSUB 3090:A8-A8-(P8)(LBLU)shot loc"+CR8+"(P3)00(F1)(LGRN)":H0(Z)-H0(Z)+1:POKE V+21,0
4390 GOSUB 3250:A=0:BL=0:IF N>H7*6 THEN RETURN
4400 IF H1(1)<2 THEN 4420
4410 A-(CL>BL):BL-6-A:BS-="two of (P8)(C/RT)your summary scores(P8)(P2)1099were poor.":GOTO 4440
4420 IF (H1(1)=0) AND (H1(2)=0) THEN A-1:RETURN
4430 BL-6:BS-="one of (P8)(C/RT)your summary scores(P8)(C/RT)was poor or below(P8)(P2)1299average."
4440 A8->"(P3)09(CLR)(RED)(P1)(P8)(P8) You are being sent (P8)(C/RT) back to level"+STR8(CL+A)
4450 A8-A8->"(P8) because "+BS+"(P1)(LGRN)":GOSUB 3250:RETURN
4460 FOR Z=0 TO E+1:POKE 16325+Z,255:NEXT Z
4470 FOR Z=0 TO E+1:INT(RND(1)*(E-B))+B
4480 IF PERK(16325+Z)-255 THEN POK2 16325+Z,2:GOTO 4510
4490 Z1-Z1+1:IF Z1>E THEN Z1-B
4500 GOTO 4480
4510 NEXT Z:RETURN
4520 GOSUB 3310:A8-="L-":STR8(CL)+"":T-0:R-":STR8(RP):GOSUB 3370

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4330 TN=TN+1:IF TN>2 THEN 2=0:RETURN
4340 IF CL<0 THEN 4370
4350 AD=PNH(876):T=PEEK(AD):AD=AD+1
4360 FOR S=1 TO 7:Z=1-INT((PEEK(AD+5)*2)/3)+.5:POKE AD+S,S:AD=AD+1:NEXT S
4370 AD=16512*(CL-5)-18560*(CL-6)-20608*(CL-6)+2048*(CL-6) AND (RP>0)
4380 Z=AD:IF PEEK(838)>=PEEK(839) THEN Z=1+1
4390 Z=0:IF Z>16 THEN PORE 33280,BC:GOSUB 3710:POKE V+21,0:IF Z>128 THEN RETURN
4400 IF Z>4 THEN Z=16
4410 IF PEEK(878)<>0 THEN 4610
4420 Z1=(INT(RND(1)*3)+1)*750:FOR S=1 TO Z1:NEXT S:GOTO 4330
4430 A8=-(F2)1091F6100(CR8)(F5)13(F7)00(BLK)":GOSUB 3300:POKE 785,FNL(GP):POKE 786,PNH(GP)
4440 PORE 251,FNL(S):POKE 252,PNH(S):Z=TN:IF (CL=1) AND (Z>5) THEN Z=5
4450 PORE 880,S:POKE 881,W:IF PEEK(824)=0 THEN RETURN
4460 A8=-(F2)0602Here is your"STR8(PEEK(824))" round shot group":S8=84/PEEK(824)
4470 IF PEEK(823)>0 THEN A8=A8-(F2)0030"STR8(PEEK(823))" shot(s) off screen"
4480 A8=A8-(F2)1094"STR8(S*50)" meters"
4490 GOSUB 3350:POKE 33265,43:RETURN
4500 IF W=0 THEN RETURN
4510 S1=0:S2=8*20:Z1=83-PEEK(838)-1:S2=0:POKE 785,FNL(GP):POKE 786,PNH(GP)
4520 A8=A8-(F2)1303(GRM)1010(F2)1399(RED)(YEL0)(F2)2999No Fixes(F8)(F8)":GOSUB 3300:Z1=0:S2=0:Z3=0
4530 AD=11*P8*160:FOR I=1 TO 6:POKE 251,FNL(AD):POKE 252,PNH(AD)
4540 PORE 881,W:POKE 880,128+I
4550 Z4=84*USR(0):A8=-(LBLU)(H10)(RED)(YEL0)(F2)0599"STR8(S*50)+" m":Z2=PEK3:DA9(1,S+8)=PEEK(910)
4560 DA9(1,6+8)=PEEK(911):DA9(1,7+2)=DA9(1,P8)-PEEK(910)
4570 IF DA9(1,7+8)<0 THEN DA9(1,7+8)=0
4580 S1=S1+PEEK(910):Z2=Z2+PEEK(911):Z3=Z3+DA9(1,7+8)
4590 A8=A8-(GRM)(F2)1399"STR8(PEEK(910))+"(RED)(F2)2299"STR8(PEEK(911))+"(YEL0)(F2)3299"
4600 A8=A8+STR8(DAT(1,7+8))+(F0)(F0)":GOSUB 3300:NEXT Z1=84-S2/4
4610 A8=-(F2)0699(LBLU)TOTAL(F2)1399(GRM)"STR8(S1)+"(F2)12299(RED)"STR8(S2)+(F2)3299(YEL0)"STR8(S3)+(F0)(P8)""
4620 A8=A8-(LBLU)(F2)0699Penalties:"STR8(PEEK(912))"(F8)""
4630 S1=9:GOSUB 3100:A8=A8*(LBLU)(F2)0699shot location:"+RIGHT8(CR8,LEN(CR8)-8)+(F8)""
4640 B8=-(F2)1499(GRM)standard met(LGRM)":IF S1<15 THEN B8=-(F2)1299(RED)standard not met(LGRM)""
4650 A8=A8+8:GOSUB 3250:RETURN
4660 AD=PNH(876):TN=PEEK(AD+3):S1=DA9(TN,6)
4670 X=(INT(RND(1)*65))+21:71:POKE AD+1,X:Y=PEEK(AD+2):TJ=PEEK(AD+11)
4680 TJ=TJ:(TJ>127)?236:IF TN=1 THEN POKE AD+15,X+8
4690 S=-(TN,1)*NT)+S1:POKE 838,S:AD=11*8*8:POKE AD+7,I
4700 PORE 800,235:POKE AD,255:GOSUB3850
4710 A8="L"+STR8(CL)+"IT"+STR8(I)+"(R"+STR8(RP)":GOSUB 3370:POKE IZ+7+S*8,RP
4720 B8=0:IF IZ>1:POKE 870,0
4730 HI=(PEEK(900)<128):IF S>128 THEN DA9(TN,6)=DA9(TN,6)+1
4740 IF S>63 THEN RETURN
4750 FOR S=1 TO 5:HI(S)=0:NEXT S:W=PNH(907):W=W+(H120)*(W-128):GOSUB 3000
4760 J=0:GOSUB 3090:A8=-(F2)05(CLR)(F5)00(F1)(WHT)steady pos"+CR8:W(S)-W(S)+1:X1=2
4770 Z8=MIDS(CR8,6,1):J=1:GOSUB 3090:A8=A8+(WHT)aiming":Z16=CR8:W(S)-W(S)+1
4780 X2=E:CR8=-(F2)1099"+88"check":IF X12 THEN CR8=-(F2)3699"+88"+ok"
4790 B8=-(WHT)breath con"+CR8:J=2:GOSUB 3090:W=88*B8+(WHT)trigger sq"+CR8
4800 W(S)-W(S)+1:X1=3:GOSUB 3090:IF HI=0 THEN CR8=-(F2)3299(RED)miss"
4805 CR8=-(F1)(P2)0008(LBLU)shot loc"+CR8:W(S)-W(S)+1:Y1=8
4810 IF (X1>2) AND (X2>3) AND (Y1>3) AND (W1=0) THEN S16=CR8(3):SD(1,8)=CR(1+P8*4,2)
4810 A8=A8+16*88:GOSUB 3280:IP (W1)=0) AND (I>2) AND (W1) THEN S040
4820 GOSUB 4050:IF S=128 THEN RETURN
4830 IF X>W-6 THEN GOSUB 3310
4840 IF HI THEN DA9(TN,8)=DA9(TN,8)+1
4850 RETURN
4860 FOR J=0 TO 3:BC(J,25)=BD(J,25)/3:NEXT J
4870 A8=8*2-251:J=0:GOSUB 3090:A8=-(F2)05(F6)00(F5)00(F7)00(CLR)(WHT)(F1)steady pos"+CR8:X1=8
4880 Z8=MIDS(CR8,6,1):J=1:GOSUB 3090:A8=A8+(WHT)aiming":CR8
4891 CR8=-(F2)1099"+88"check":IF X1>2 THEN CR8=-(F2)3699"+88"+ok"
4903 A8=A8-(WHT)breath con"+CR8
4909 J=2:GOSUB 3090:A8=A8+(WHT)trigger sq"+CR8:J=3:GOSUB 3090
5100 S=8:Z=8:GOSUB 3300:POKE 785,FNL(GP):POKE 786,PNH(GP):POKE 251,FNL(S)
5110 PORE 252,FNL(S):POKE 880,S:POKE 881,S:Z=USR(0):A8= ""
5120 IF PEEK(823)>0 THEN A8=-(BLK)(F2)0921"STR8(PEEK(823))" shot(s) off screen"
5130 PORE 823,S:POKE 824,13:POKE 253,13:BYT CO:A8=A8+(SWLC)(LGRM)":GOSUB 3250
5140 PORE 33265,43:RETURN
5160 A8=A8-(F2)1303(GRM)1010(F2)2199(RED)101000(YEL0)(F2)2999No Fixes(F8)(F8)":GOSUB 3300
5170 PORE 785,FNL(GP):POKE 786,PNH(GP):W1=0:W1=0:W1=0:W1=0:RETURN
5180 FOR I=1 TO 6:POKE 251,FNL(I):POKE 252,FNL(I):POKE 881,PEEK(824)
5190 PORE 880,128+I:Z=24+USR(0):A8=-(LBLU)(F2)0599"STR8(S*50)+" m"
5200 HI=HI*PEEK(910):W=HI*PEEK(911):Z=DA9(I,4)-PEEK(824):IF S3<0 THEN Z3=0
5210 HI=HI*PEEK(910):W=HI*PEEK(911):Z=DA9(I,4)-PEEK(824)+(RED)(F2)2299"STR8(PEEK(911))"
5220 A8=A8-(YEL0)(F2)3299"+88"STR8(S3)+(F0)(F0)":GOSUB 3300:NEXT I:Z4=Z4/PI:W1=1
5230 A8=-(F2)0699(LBLU)TOTAL(F2)1399(GRM)"STR8(W1)+(F2)2299(RED)"STR8(W1)+(F2)3299(YEL0)"STR8(W1)+(F0)(F8)""
5240 GOSUB 5020:A8=A8:GOSUB 3250:RETURN
5250 A8=-(F2)091F6100(F5)00(F7)00(CLR)(RED)(SWLC)(F1)(F2)03024 fundamentals of(F2)0209rifile marksmanship"
5260 A8=A8-(GRM)(F2)0109(F1): (F1)Steady Position(F2)0112(F1), (F1)Aiming(F2)0115(F1), (F1)Breath Control"
5270 A8=A8-(F2)0109(F1), (F1)trigger squeeze(F1)(LGRM)":GOSUB 3250:RETURN
5280 A8=-(F2)091F6100(F5)00(F7)00(CLR)(RED)(SWLC)(F1)(F2)0407You did not meet(F2)0710the standard."
5290 A8=A8-(F2)0219Prepare to fire(F1)(LGRM)(F2)0023Pull trigger to begin(F3)00":BC=2
5300 GOSUB 3300:GOSUB 3260:RETURN
5350 A8=-(F2)091F6100(F5)00(F7)00(CLR)(GRM)(SWLC)(F1)(F2)0709standard met.(F2)1113Continue.(F3)00":GOSUB 3300
5360 FOR S=1 TO 8:00:NEXT S:RETURN
5370 B8="":IF ((W1 AND 7)*5)=0 THEN S600
5380 B8=STR8(((W1 AND 224)/32)+1)
5390 B8=-(F2)2400W"+STR8((W1 AND 7)*5)+"(F4)0"+RIGHT8(B8,1)
5400 A8=-(HOME)(BLK)(RV08)(SWLC)"A8=B8+(F6)0"+CR8(BC+88):GOSUB 3300:RETURN
5410 A8=A8+7": (C/LP)(C/LP)(C/LP)(C/LP)":GOSUB 3300:W8= ""
5420 GET A8:IF A8="" THEN S620
5430 IF (A8=CR8(13)) OR (LEN(B8)>3) THEN A8=(C/UP)(V8)":GOSUB 3300:A8=B8:RETURN
5440 IF A8>CR8(20) THEN S670
5450 IF B8<"" THEN B8=LEFT8(B8,LEN(B8)-1):A8=(C/LP)(C/LP)(C/LP)(C/LP)":GOSUB 3300
5460 GOTO S620
5470 IF (A8<0) OR (A8>16) THEN S620
5478 IF (A8>="a") AND (A8<="z") THEN A8=CR8(ABC(A8) OR 128)
5480 B8=B8+A8:A8=A8+(C/LP)":GOSUB 3300:GOTO S620
5490 FOR S=12 TO 12+363 STEP 8:POKE S,295:NEXT S:RETURN
5700 PORE 49168,B8:BYT 49162:RETURN
5710 PORE 785,10:POKE 786,192:POKE 49168,B8:S=USR(2):RETURN

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5720 POKE 231,1:BB=12:GOOSUB 3700:AB=""::GOOSUB 3250:POKE V+21,0
5730 S1=32768:BB=7:GOOSUB 3310:GOOSUB 3260:RETURN
5740 IF WI=0 THEN RETURN
5750 AB=STR8((WI AND 7)*8):BB=STR8(INT(WI/32)+1):BB="0"+RIGHT8(BB,1)
5760 AB=(P2)09(P3)19(P7)00(CLR)(BLR)(P1)(P2)0601WIND="+AB+" mph (P4)"*BB:BB=(P2)0105Offset needed"
5770 B=INT(WI/32):IF (B>0) AND (B<4) THEN S800
5780 BB=(P2)0204(wind towards you)":IF B=0 THEN BB=(P2)0004(wind away from you)"
5790 BB=BB*(P2)0407no offset needed"
5800 AB=AB+BB*(P1)(P2)111300 m(P2)1913150 m(P2)071550 m":GOOSUB 3200
5810 POKE 231,2:BB=12:GOOSUB 3700:AB=(BLR)":GOOSUB 3250:POKE V+21,0:RETURN
5820 CR8=(P2)1799(GRN)Expert":IF HI<36 THEN CR8=(P2)1499(YEL)Sharpshooter"
5830 IF HI<30 THEN CR8=(P2)1699(YEL)Marksmen"
5840 IF HI<23 THEN CR8=(P2)1499(RRD)Unqualified"
5850 IF (HI(0)=1)AND(HI>22) THEN CR8=(P2)1699(YEL)Marksmen (because you had to refire)"
5860 RETURN
6000 REM THE FOLLOWING IS THE CRITERION FOR GOOD,AVERAGE,BELOW AVERAGE,POOR
6010 DATA 2,2,3,3,10,5:REM AB SUP
6020 DATA 1,6,3,5,6,5,9:REM AIM SUP
6030 DATA 2,3,3,8,10,5:REM TB SUP
6040 DATA 1,6,3,5,6,5,9:REM SL VMS
6050 DATA 4,6,1,9,3,12:REM TB VMS
6060 DATA 2,4,3,8,11:REM AIM VMS
6070 DATA 4,7,11,14,8:REM TB VMS
6080 DATA 2,4,3,8,11:REM SL VMS
6090 DATA 39,35,30,26:REM B178
6100 DATA 1,3,3,5,6,5,9:REM ACCURACY
6110 DATA 3,2,47,34,3,4,3,23,37,9,4,6,11,13,9
6120 DATA 4,4,11,15,6,3,2,11,15,7,2,1,11,16,6
6130 DATA "(P2)3299(RRD)poor","(P2)2299(GRN)below avg","(P2)2699(YEL)average","(P2)5299(LGR)good"
6140 DATA "(P2)2299(GRN)excellent"

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*3400
;BRM.3400.TST FOR BRM CARTRIDGE
JMP  ENABLE
JMP  DSABLE
JMP  ROTATZ
JMP  SEEVAL
JMP  NOTRC
JMP  BANG
JMP  WAIT
JMP  SCENE
JMP  MATH
JMP  ADJLOC
JMP  RADERR
JMP  BNTGRP
JMP  COLORS
JMP  WHISTL
JMP  RISCOR
JMP  EXPTR
.OPT  NOL
PROGRAM -49161
SELBSB -49162
;
; CONVENTIONS USED
;PROCEDURE IODOCK
;PURPOSE OF PROCEDURE
;NECESSARY ACTIONS BEFORE CALL
;HOW TO CALL
;WHAT USER CAN EXPECT AFTER CALL
;
; LIB MACROS-VARS
.OPT  NOL
;820-1023 IS UNUSED IF NO CASSETTE
CHOICE -820
STOP -821
HOLD1 -823
HOLD2 -824
HSRT -825
HOLDA -826
HOLDX -827
HUNRD -828
SUMR20 -829
HOLD -831
DELAY -832
CUR1 -833
OFFX -834
OFFY -836
SHOTS -836
HSIRQ -839
HSIRQ -840
HSIRQ -841
HSIRQ -842
HSIRQ -843
HSIRQ -844
HSIRQ -845
HSIRQ -846
XVAL -847 ;X BULLET STRIKE
YVAL -848 ;Y BULLET STRIKE
SORTAF -851 ;0 RDGS TO SORT AFTER
STSIZR -852 ;0 TO PUT IN BRTBUF
BRTBUF -853
CURRT -853
HOLDY -864
TRAJ -866
JRO -867
SSCOL -868
SDCOL -869
FLAGS -870
CODE1 -871
CODE2 -872
COLOR -873
OFFSCR -874
HAFSEC -875
TARORD -876
CRSLDA -877
CURTF -879
HOLD3 -880
HOLD4 -881
CURTAR -882
CUR2 -883
IRO2 -884
COPY -885
CODE3 -886
CODE4 -887
TAFFP -888
MURD60 -889
EOLLOAD -891
HITSFR -893
SUPX -894
HSIZE -895
TIMES -897
FSTAT -898
MAXSH -899
LASTSH -900
HITS -910
MISS3 -911
PENAL -912
MAXVAL -913
WIND -914
WDRIFT -915
;
;NMD
;MAC
;LDA
;STA
;JSR
;OPT
;END
;LIB
;IRQSTUFF FOR BRM CARTRIDGE
;PROCEDURE ENABLE
;PREPARES IRQ TO TAKE READINGS
;B:NONE
;C:SYS ENABLE
;A:NONE
ENABLE BRI
LDA $0
STA $6334
LDA $3265
AND $127
STA $3265
LDA $250
STA $3266
LDA $5
STA $3274
LDA $3273
STA $314,START
LDA $0
STA CUR1 ,20 RDGS SP
STA CUR2 ,60 RDGS SP
STA IRO
STA BORCOL
STA HUNRD ;0 READINGS P
STA SORTAF ;0 SORT AFTER
LDA $5
STA STSIZE
LDA $1
STA HAFSEC
STA H7IRQ
CLI
RTS
;
;PROCEDURE DISABLE
;RETURNS IRQ VECTOR TO NORMAL
;B:NONE
;C:SYS DISABLE
;A:NONE
DISABLE FFI
LDA $1
STA $6334
LDA $240
STA $3274
LDA $3273
STA $3273
ADDR $314,$EA31
CLI
RTS
;
;PROCEDURE START (IRO)
;INTERRUPT CONTROLLER ROUTINE
;
;IRO HAS THE FOLLOWING VALUES:
;128: TAKE READINGS BEFORE
;64: TAKE READINGS AFTER
;32: GET COLLISION DATA
;16: SOUND NEEDED
;8: WAITING FOR TRIGGER RELEASE
;4: SHOT HAS BEEN FIRED
;2: NEW TARGET DISABLE
;1: NO BULLETS LEFT
;
;IRO2 HAS THE FOLLOWING VALUES:
;128: RETURN AFTER ONE SHOT FIRED
;64: RETURN WHEN NO TARGETS UP
;32: NO HIT/MISS DETECTION
;16: NO CROSS DISPLAYED
;8: CROSS FOR MISS ONLY
;4: NO DATA SAVE TO INFO2
;2: DISPLAY TARGET NUMBER
;1: REPLAY
;
;TARORD (TARGET ORDER) IS SET UP
;IN THE FOLLOWING MANNER:
;BYTE 0:6 TARGETS THIS HALF SECOND
;1:STARTING X COORDINATE
;2:STARTING Y COORDINATE
;3:TARGET # (FOR ID)
;4:TARGET SPRITE POINTER
;5:BIT 7:SET TO EXPAND X
;6:SET TO EXPAND Y
;7:RIGHT X
;8-9:SPRITE COLOR
;

```


INC SPC	BEQ IRQ360	ASL A
INC SPC	LDY CURSR1	ASL A
LDA H2IRO	INC CURJAT	ASL A
STA (FFB),Y	LDY #5	TAX
INY	IRQ350	SHN010 LDA HUMRDATA,X
STY CUR1	LDY #0	STA 4256,Y
DIW C MUMR20	IRQ350 LDA H2IRO	INX
LDY CURSR1	STY CURSR1	CPY #0
INC CURSR1	LDY #0	BCC SHN010
CPY #5	CLC	LDA CURNUM+1
BCC IRQ290	ADC #5	ASL A
LDY #0	TAY	ASL A
STY CURSR1	LDA R2IRO	TAX
IRQ290 LDA H2IRO	STA SRTBUF,Y	SHN020 LDA HUMRDATA,X
STA SRTBUF,Y	DEC	STA 8256,Y
TIA	SHN020 DEC	INX
CLC	HUMRD / X READINGS	INY
ADC #5	IRQ360 / TO TAKE	CPY #16
TAY	LDY #1	BCC SHN020
LDA H2IRO	LDY #0 / ZERO STACK	RTS
STA SRTBUF,Y	STA CUR1 / PTR IF DONE	HUMRDATA .BYTE
LDA IRQ / HAS TRIGGER	STA CUR2	195,183,145,137,183,153,195,231,231,19
AND #12 / BEEN	STA CURSR1	9,231,231,231,129
BNE IRQ300 / RELEASED?	LDY #1	CPY #16
LDA S6321 / TRIGR PULL	STA R192	BCC SHN020
CHU #247	STA IRQ	RTS
BNE IRQ300	LDY #0 / ZERO STACK	HUMRDATA .BYTE
BIT BORCOL / LIGHTPEN	STA CUR1 / PTR IF DONE	195,183,153,249,243,207,159,129,255,195,15
BPL SHN020 / ON SCREEN?	STA CUR2	3,249,227,249,153
LDA #4	LDY #1	.BYTE
STA S3280	STA R7IRO	195,255,249,241,225,153,129,249,249,255,12
IRQ300 JMP IRQ340	BIT IRQ2	9,159,131,249,249
SHN020 JSR RANG	BMI IRQ170	.BYTE
LDA #0 / IF ANYONE	BVC IRQ380	195,255,249,241,225,153,131,153,153,195,25
STA XVAL / HAS THE	LDY V+21	5,123,153,243,231
STA XVAL+1 / REVELATION	AMD #251	.BYTE
STA YVAL / THAT SORT-	BNE IRQ380	231,231,231,255,195,153,153,195,153,153,19
STA YVAL+1 / INC REALLY	IRQ370 LDA IRQ	5,255,195,153,153
LDA H2IRO / IS THE	AMD #63	.BYTE
BEQ IRQ320 / ANSWER,	STA IRQ	193,249,153,195,255,255,255,255,255,255,25
ASL A / REMOVE	ONSCRN LDA S3267 / X READINGS	5,255,255
LDX #0 / THESE Z8	LDY #1	.END
BCC IRQ310 / REINSET	LDX S3268 / Y READINGS	.LIB REPLAY
INX / THE CALL TO	STX H2IRO	REPLAY PCLR ROM CARTRIDGE
IRQ310 CLC / GETTY IN	CMP LPCMXP	REPLAY DEC H7IRO
ADC OFFX / CTMOV	BNE ONSC30	BEQ RPLO10
STA XVAL / ---	BIT BORCOL	JMP RPLO90
TXA / ---	BMI ONSC20	RPLO10 LDA #3
ADC OFFX+1 / ---	INC BORCOL	STA H2IRO
STA XVAL+1 / ---	LDA BORCOL	LDY CUR1
LDA H2IRO / ---	CMP #30	INY
CLC / ---	BCS ONSC10	CPY STOP / LAST RDG?
ADC OFFY / ---	RTS	BNE RPLO20
STA YVAL / ---	ONSC10 LDA S3280	LDA YVAL
IRQ32J LDA IRO	ORA #128	BEQ RPLO50
AND #127	STA BORCOL	SEC
ORA #76	ONSC10 STA LPCMXP	SBC TRAJ
STA IRO	STX LPCMXP	STA H6IRO
LDA #0 / FORMERLY 3	BIT BORCOL	LDA XVAL
STA SORTAF	BPL ONSC40	BEQ RPLO50
LDA #10	LDA BORCOL	SEC
STA HUMRD	STA S3280	SBC WDRIFT
JSR INFOB	ONSC40 LDA #0	TAX
LDT #5	STA BORCOL	SBC WDRIFT+1
LDA MUMR20	RTS	STA H5IRO
STA (FFB),Y	ONSC40 STA LPCMXP	TXA
STA LASTSH,Y	STX LPCMXP	LDX RSIRO
INY	BIT BORCOL	DEY
LDA MUMR20+1	ONSC40 STA SHOTS	JMP RPLO40
STA (FFB),Y	ASL A	RPLO20 DEY
STA LASTSH,Y	ASL A	LDA 14848,Y / BULKY
LDA MUMR60	ASL A	BEQ RPLO50
BCC #1	ROL SPC	CLC
STA LASTSH+7	ADC #1:INFO	ADC OFFY
LDA MUMR60+1	STA #FB	STA H6IRO
BCC #0	LDA SPC	LDX #0
STA LASTSH+8	ADC #2:INFO	LDA 14592,Y / BULK
LDA #0	STA #FB	BEQ RPLO50
STA CUR1	LDA SPC	ASL A
STA CUR2	ADC #3:INFO	BCC RPLO30
STA MUMR20	STA #FB	LDX #1
STA MUMR20+1	RTS	RPL030 CLC
STA MUMR60	INCNUM LDX CURNUM+1	ADC OFFX
STA MUMR60+1	INX	STA H4IRO
IRQ340 PLA	CPX #10	ADC OFFX+1
STA SPC	BCC INC010	STA H5IRO
PLA	LDX #0	LDA H4IRO
STA #FB	INC010 STA CURNUM	RPL040 SEC
JMP #EAJ1 / NORMAL IRQ	LDX #0	SBC H1IRO / TARRX L
LDY CUR2 / STACK PTR	INC010 STA CURNUM	STA H4IRO / BULK-TARRX
INC CUR2	LDX #0	LDA H5IRO
LDA S3267 / X LOCATION	INC020 STA CURNUM+1	SBC H2IRO / TARRX H
STA H2IRO	RTS	STA H5IRO
STA XLPAGE0,Y	SHONUN LDY #0	LDA H4IRO
LDA S3268 / Y LOCATION	LDX #80 / LEAD SPACY	CIC
STA H2IRO	LDA CURNUM	ADC #231 / 254-23 SPOT
STA YLPAGE0,Y	BEQ SHN010	STA V+2 / OFFSET
LDA SORTAF		LDA H5IRO

LDA 72	STA SUMX	STA SUMX+1	JSR MUL2
STA HOLDAD+1	STA HOLD3	ADC SUMX	CIC
LDA 1	STA HOLD4	STA SUMX	ADC SUMX+1
PHA	STDL10 LDA 1	TIA	STA SUMX+1
LDA 654	PHA	ADC SUMX+1	DRY
STA 1	LDA 654	STA SUMX+1	BMI AVG020
LDY 623	STA 1	DRY	CPT 6FB
DEY	LDY TIMES	BMI AVG020	BCS AVG010
BPL ADJ010	LDA (8FD),Y	CPT 6FB	BCS AVG010
PLA	TAX	AVG020 PLA	PLA
STA 1	BIT HOLD4	AVG020 STA 1	STA 1
LDX #0	BMI STDL20	AVG030 LDA SUMX+1	AVG040
STX HOLDX	STA HOLD3	BNE AVG040	AVG040 LDA SUMX
ADJ020 LDA HOLDAD	LDA #128	BCS AVG010	BCS AVG010
LDY HOLDAD+1	STA HOLD4	AVG040 STA 1	AVG040 STA 1
JSR PFA1FA1	TIA	AVG040 BCC AVG040	AVG040 BCC AVG040
JSR UNPLOT	ADC STDL20	AVG040 BNE AVG040	AVG040 BNE AVG040
LDA 100 /X VALUE	LDY HOLD4	AVG040 AVG040	AVG040 AVG040
ASL A	ORA #64	AVG040 STA SUMX	AVG040 STA SUMX
LDY 40	STA HOLD4	BCS HS188	BCS HS188
BCC ADJ030	TIA	STA SUMX+1	STA SUMX+1
INT	ADC STDL20 JSR MUL2	BCS 40	BCS 40
ADJ030 CLC	STA HOLD1	AVG050 LDY HOLD1	AVG050 LDY HOLD1
ADC OFFX	STX HOLD2	AVG050 INTX	AVG050 INTX
STA LASTSH+1 /BULLET X	CIC	AVG050 STA 1	AVG050 STA 1
TYA	ADC SUMX	AVG050 BCC AVG050	AVG050 BCC AVG050
ADC OFFX+1	STA SUMX+1	AVG050 LDX HOLD1+1	AVG050 LDX HOLD1+1
LSR A	ADC HOLD2	RANGE LDA #0	RANGE LDA #0
BCR LASTSH+1	LDA HOLD2	STA HS188	STA HS188
LDA 101 /Y VALUE	STA SUMX+1	LDY 625	LDY 625
CLC	PLA	STA TIMES	STA TIMES
ADC OFFY	STA 1	RANG010 LDA 1	RANG010 LDA 1
STA LASTSH+2 /BULLET Y	LDY HOLD1	PLA 654	PLA 654
LDX HOLDX	ADC HOLD2	RTS	RTS
LDA TEMP+3,X	JSR FLOAT	BCS RAM030	BCS RAM030
STA LASTSH+3	JSR FA1FA2	RAM030 CMP HS188	RAM030 CMP HS188
LDA TEMP+4,X	LDY HOLD1	BCC RAM040	BCC RAM040
STA LASTSH+4	LDA HOLD2	RAM040 STA HS188	RAM040 STA HS188
JSR RADERR	JSR FLOAT	DEY HS188	DEY HS188
LDX HOLDAD	ADC MULPLY	STA RAM050	STA RAM050
LDY HOLDAD+1	LDA #85C	RTS	RTS
JSR FA1FA1	LDY 40	BCS RAM030	BCS RAM030
LDA HOLDAD /SET UP	JSR MEMFA2	RAM030 STA 1	RAM030 STA 1
CLC / FOR	JSR ADD	RTS	RTS
ADC #10 / SHOT LOC	JSR FA13C	BCS RAM040	BCS RAM040
STA HOLDAD / SCORE	DEC TIMES	RAM040 STA HS188	RAM040 STA HS188
LDA HOLDAD+1	LDY TIMES	DEY HS188	DEY HS188
ADC #0	BMI STDL40	STA RAM050	STA RAM050
STA HOLDAD+1	CPY HS188	RTS	RTS
LDX HOLDX	BCS STDL10	BCS RAM020	BCS RAM020
LDA TEMP+1,X /BULLET X	STDL40 PLA	RAM050 PLA	RAM050 PLA
ASL A	STA HS188	STA 1	STA 1
LDY 40	BIT HOLD4	RTS	RTS
BCC ADJ040	BVG STDL50	BCS TIMES	BCS TIMES
INT	LDA #0	JSR MUL2	JSR MUL2
ADJ040 CLC	TAY	TAY	TAY
ADC OFFX	JSR FLOAT	RTS	RTS
STA TEMP+1,X	RTS	JSR FLOAT	JSR FLOAT
TYA	STDL50 LDY SUMX	RTS	RTS
ADC OFFX+1	LDA SUMX+1	RADERR LDY #0	RADERR LDY #0
LSR A	JSR FLOAT	LDA LASTSH+1 /BULLET X	LDA LASTSH+1 /BULLET X
BCR TEMP+1,X	JSR FA1FA2	JSR A	JSR A
LDA TEMP+1,X	LDY SUMX	BCC RAD010	BCC RAD010
STA INFO+1,X	LDA SUMX+1	INTX	INTX
STA INFO+1,X	JSR FLOAT	RAD010 STA CODE3	RAD010 STA CODE3
STA LASTSH+1	ADC MULPLY	STX CODE4	STX CODE4
LDA TEMP+2,X /BULLET Y	JSR FA1FA2	LDX #0	LDX #0
CLC	LDA #0	LDA LASTSH+3 /TARGET X	LDA LASTSH+3 /TARGET X
ADC OFFY	LDY HS188	ASL A	ASL A
STA INFO+2,X	JSR FLOAT	BCC RAD020	BCC RAD020
STA INFO+2,X	JSR DIVIDE	INTX	INTX
STA LASTSH+2	LDA #85C	RAD020 SEC	RAD020 SEC
JSR RADERR	JSR MEMFA2	SSC CODE3	SSC CODE3
LDX HOLDAD	LDY HS188	STA CODE3	STA CODE3
LDY HOLDAD+1	JSR SUBRT	TIA	TIA
JSR FA1FA1	JSR FA1FA2	SSC CODE4	SSC CODE4
LDA HOLDAD /SET UP	LDA #0	STA CODE4	STA CODE4
CLC / FOR NEXT	LDY HS188	LDY CODE3	LDY CODE3
ADC #10 / AIMING	DEY	JSR FLOAT	JSR FLOAT
STA HOLDAD / SCORE	JSR FLOAT	JSR FA1FA2	JSR FA1FA2
LDA HOLDAD+1	JSR DIVIDE	LDY CODE3	LDY CODE3
ADC #0	LDA 102 /FA1 SIGN	LDA CODE4	LDA CODE4
STA HOLDAD+1	AND #127	JSR FLOAT	JSR FLOAT
LDA HOLDX	STA 102 /ABS	JSR MULPLY	JSR MULPLY
CLC	JSR SQRT	JSR FA13C	JSR FA13C
ADC #0	RTS	LDX #0	LDX #0
STA HOLDX	AVG LDA #0	LDA LASTSH+2 /BULLET Y	LDA LASTSH+2 /BULLET Y
CIC #24	STA SUMX	SEC	SEC
BCS ADJ050	STA SUMX+1	BBC LASTSH+4 /TARGET Y	BBC LASTSH+4 /TARGET Y
JMP ADJ020	STA HOLD1	BCS RAD030	BCS RAD030
ADJ050 RTS	STA HOLD1+1	DEX	DEX
STDEV PHA	STA 1	RAD030 STA CODE3	RAD030 STA CODE3
LDA #0	PLA	RTS	RTS
TAY	LDA #54	JSR CODE4	JSR CODE4
JSR FLOAT	STA 1	LDY CODE3	LDY CODE3
JSR FA13C	LDY #FC	JSR FLOAT	JSR FLOAT
LDA #0	AVG010 LDA (8FD),Y	JSR FA1FA2	JSR FA1FA2


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SHT150 INC  HOLD1
SHT160 LDA  #FB
          CLC
          ADC  #8
          STA  #FB
          LDA  #FC
          ADC  #0
          STA  #FC
          DEC  HOLD4
          BEQ  SHT170
          JMP  SHT030
SHT170 PLA
          STA  1
          BIT  HOLD3
          SPL  SHT180
          RTS
SHT180 LDY  #0
SHT190 LDX  #0
          LDA  TEMP.Y
          CMP  #255
          BNE  SHT240
          STA  #FB
          ASL  A
          BCC  SHT200
          INX
          SEC
          BBC  #1
          STA  XVAL
          STA  HOLD4
          TIA
          BBC  #0
          STA  XVAL+1
          STA  HOLD4
          LDA  TEMP+1.Y
          STA  #FC
          SEC
          BBC  #1
          STA  XVAL
          LDA  #3
          STA  CODE3
          STA  CODE4
          STA  JSR  BITPLT
          DIMC  XVAL
          DEC  CODE3
          BNE  SHT210
          LDA  HOLD4
          STA  XVAL
          LDA  HOLD4
          STA  XVAL+1
          INC  XVAL
          LDA  #3
          STA  CODE3
          DEC  CODE4
          BNE  SHT210
          INY
          INY
          TIA
          TAX
          SHT220 LDA  TEMP.X
          CMP  #255
          BEQ  SHT190
          CMP  #FB
          BNE  SHT230
          LDA  TEMP+1.X
          CMP  #FC
          BNE  SHT230
          INC  TEMP.X
          INC  TEMP+1.X
          SHT230 INX
          INX
          JMP  SHT220
SHT240 JSR  EXITAR
          RTS
          BITPLT STA  HOLD4
          LDA  #0
          STA  #FD
          STA  #FE
          STA  #AA
          STA  XVAL+1
          PL020 LDA  XVAL
          AND  #248  /INT(Y/8)*320
          LDX  #3
          PL030 ASL  A
          ROL  #AA
          DEX
          BNE  PL030
          STA  #A3
          ADC  #A3
          STA  #FE
          ADC  #A4
          STA  #FE
          DEX
          BNE  PL040
          LDA  XVAL  :#*INT(X/8)
          AND  #248
          CLC
          ADC  #FD
          STA  #FD
          LDA  #VAL+1
          ADC  #0
          STA  #FE
          LDA  #VAL+7
          AND  #7
          TAY
          LDA  #VAL  :X AND 7
          AND  #7
          STA  #A3  :7-(X AND 7)
          TAX
          LDA  #1
          CPI  #0
          BEQ  PL060
          PL050 ASL  A  /3*(7-(X
          DEX  : AND 7))
          BNE  PL050
          PL060 BIT  C0DICE
          BPL  PL070
          ORA  #FD.Y
          JMP  PL080
          PL070 EOR  #FD.Y
          PL080 STA  #FD.Y
          LDY  #OLDY
          RTS
          .END
/PROCEDURE HISCOR
/THIS PROCEDURE CALLES THE HISCOR
/ PROCEDURE IN CHOBKI. THE ONLY
/ REASON IT IS HERE IS BECAUSE
/ THE INITIALS BUFFER IS UNDER
/ ROM AND ROUTINES RUNNING OFF
/ THE EPROM CANNOT BANK OUT ROM
/ WITHOUT CRASHING. IT MOVES
/ THE INITIALS BUFFER TO TEMP
/ BEFORE CALLING AND MOVES IT
/ BACK AFTER THE CALL. CODE1
/ AND FAI MUST BE SET (IF APP.)
/ BEFORE CALLING THIS ROUTINE.
HISCOR LDA  1
          PIA
          LDA  #54
          STA  1
          LDY  #79
          HIS010 LDA  IMIBUF.Y
          STA  TEMP.Y
          DEY
          BPL  HIS010
          STA  1
          LDA  #24
          STA  #9160
          JSR  SELSUB
          LDY  #79
          HIS020 LDA  TEMP.Y
          STA  IMIBUF.Y
          DEY
          BPL  HIS020
          RTS
          .OPT  LIST
          .END
          #-32768
/MILCHOBKI.TXT
          JMP  CTRMOV
          JMP  RANDOM
          JMP  DODATA
          JMP  GETXY
          JMP  HELPSC
          JMP  REKREP
          JMP  YESNO
          JMP  DESCRP
          JMP  HISCOR
          .LIB  MACROS-VARS
          .END
          .OPT  NOL
          RANG  #-3415
          DSABLE  #-3403
          ENABLE  #-3400
          MOTTRG  #-3412
          ROTATE  #-3406
          WAIT  #-3418
          WHISTL  #-3436
          PRGNUM  #-9161
          LETHL  #-9105
          .LIB  CTRMOV
          CTRMOV IM  MILCHOBKI.TXT
          CTRMOV JSR  ENABLE
          LDA  #0
          STA  #ITOPR
          STA  #NUM20
          STA  #NUM20+1
          STA  #NUM60
          STA  #NUM60+1
          STA  #STAT
          JSR  #B1BF
          LDA  #01
          STA  #RQ
          LDA  #00
          STA  #RQ2
          CTR010 LDA  #0
          STA  #OPFSCR
          JSR  #MDVESP
          CTR020 JSR  PAUSE
          BCS  CTR030
          JMP  CTR410
          CTR030 LDA  #ORTAF
          BNE  CTR030
          JSR  #GETXY  ;NO :IRET ORT
          STA  #CLOSER
          STA  #CURTAR
          TAX
          BNE  CTR040
          JMP  CTR110
          CTR040 LDA  #SPECIL,X
          STA  #SPECIL
          LDA  #0
          STA  #DRIFT+1
          LDA  #WIND
          AND  #36
          BEQ  CTR070
          LDA  #DRIFT,X
          ASL  A  ;RANGE=8
          ASL  A
          ASL  A
          STA  #DRIFT
          LDA  #WIND  ;GET SPEED
          AND  #7
          CLC  ;ADD TARGET
          ADC  #DRIFT  ;OFFSET
          TAY
          LDA  #WIND  ;FULL OR
          AND  #32  ;HALF VALUE?
          BNE  CTR060
          LDA  #TABLE.Y
          CTR070 JMP  CTR070
          CTR060 LDA  #TABLE.Y
          AND  #15
          CTR070 STA  #WDRIFT
          BIT  #NEGATIVE
          BPL  CTR080  ; DIRECTION?
          DEC  #255
          EOR  #0
          STA  #WDRIFT
          DIMC  #WDRIFT
          CTR080 LDA  #DRIFT,X
          STA  #TRAJ
          LDA  #TIMEPL.X
          BZG  CTR110
          STA  #CURTF
          LDX  #OLD1
          LDA  #X
          CTR090 STA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          BZG  CTR100
          EOR  #255
          AND  #V+21
          STA  #V+21
          LDA  #0
          STA  #WFTSCR
          CTR100 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR110 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR120 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR130 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR140 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR150 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR160 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR170 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR180 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR190 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR200 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR210 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR220 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR230 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR240 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR250 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR260 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR270 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR280 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR290 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR300 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR310 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR320 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR330 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR340 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR350 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR360 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR370 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR380 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR390 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR400 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR410 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR420 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR430 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR440 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR450 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR460 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR470 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR480 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR490 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR500 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR510 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR520 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR530 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR540 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR550 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR560 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR570 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR580 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR590 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR600 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR610 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR620 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR630 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR640 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR650 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR660 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR670 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR680 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR690 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR700 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR710 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR720 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR730 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR740 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR750 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR760 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR770 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR780 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR790 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR800 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR810 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR820 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR830 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR840 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR850 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR860 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR870 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR880 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR890 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR900 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR910 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR920 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR930 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR940 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR950 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR960 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR970 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR980 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR990 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1000 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1010 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1020 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1030 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1040 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1050 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1060 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1070 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1080 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1090 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1100 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1110 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1120 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1130 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1140 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1150 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1160 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1170 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1180 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1190 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1200 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1210 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1220 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1230 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1240 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1250 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1260 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1270 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1280 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1290 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1300 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1310 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1320 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1330 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1340 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1350 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1360 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1370 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1380 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1390 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1400 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1410 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1420 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1430 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1440 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1450 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1460 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1470 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1480 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1490 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1500 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1510 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1520 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1530 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1540 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1550 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1560 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1570 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1580 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1590 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1600 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1610 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1620 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1630 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1640 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1650 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1660 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1670 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1680 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1690 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1700 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1710 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1720 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1730 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1740 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1750 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1760 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1770 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1780 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1790 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1800 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1810 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1820 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1830 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1840 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1850 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1860 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1870 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1880 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1890 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1900 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1910 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1920 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1930 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1940 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1950 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1960 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1970 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR1980 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR1990 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR2000 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR2010 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR2020 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR2030 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR2040 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR2050 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR2060 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR2070 LDA  #HOLD2
          JSR  #MOVESP
          JSR  #PAU010
          LDA  #OPFSCR
          CTR2080 LDA  #V+21
          AND  #HOLD3
          BZG  CTR110
          LDX  #OLD1
          LDA  #V,X
          CTR2090 LDA  #HOLD2
          JSR  #MOVESP
```

```

LDX XVAL+1
BEQ CTR120
ORA #1
CTR120 STA V+16
LDA V+20 ; TURN OFF
AND #254 ; MULTICOLOR
STA V+28 ; FOR SPR 0
LDA #34 ; BULLET
STA 2040
LDA #12 ; MED GRAY
STA V+39
LDA #0
STA BSCOL
LDA IRQ2 ; NO CHECK
AND #32 ; FOR
BNE CTR150 ; COLLISION?
LDA V+21 ; TURN ON FOR
ORA #1 ; COLLISION
STA V+21 ; CHECK
LDX #2
CTR130 LDA IRQ ; CHECK FOR
ORA #32 ; COLLISION
STA IRQ
CTR140 LDA IRQ
AND #32
BNE CTR140
DEX
BNE CTR130
LDA V+21 ; TURN OFF
AND #254 ; BULLET
STA V+21
CTR150 LDA #0
STA SPC
LDA SHOTS
ASL A
ASL A
ASL A
ROL SPC
CLC
ADC #<INFO
STA SFB
LDA SPC
ADC #>INFO
STA SFC
LDA BSCOL
AND #254
TAY
LDA #2
STA CODE3 ; 2*(HIT SPR0)
LDX #1 ; HIT SPR0
CTR160 TYA
BTX CODE2
AND CODE3
CLC
BNE CTR170
INX
ASL CODE3
BCC CTR160
LDX #0
STX CODE2
LDX CURTAR
CTR170 LDA TARNUM,X
BCC CTR180
ORA #128
JMP CTR190
CTR180 INC HIT5
CTR190 LDY #0
STA TARNUM
STA (SPB).Y ; TARGET ID
STA LASTSH,Y
INY
LDA XVAL+1
LSR A
LDA XVAL
ROR A
STA (SPB).Y ; BULX/2
STA LASTSH,Y
INY
LDA SPECIL,X
STA SPECIL
LDA CENX,X
STA CENX
LDA CENY,X
STA CENY
ASL A ; FOR SPR XY
PFA
LDA V+15
CTR200 LSR A ; PUT RIGHT
DEX ; X IN
BPL CTR200 ; CARRY
PLA
TAX
LDA V,X
ROR A ; RIGHT X
CLC ; ADD CENTER X
ADC CENX ; OFFSET
STA (SPB).Y ; TARNX/2
STA LASTSH,Y
INY V+1,X
LDA V+1,X ; ADD CENTER Y
ADC CENY ; OFFSET
STA (SPB).Y ; TARY
STA LASTSH,Y
LDA IRQ2 ; IS THIS SHOT
AND #1 ; A REPEAT?
BNE CTR220
LDA SFB ; STORE IN
CLC ; 2ND INFO
ADC #<44 ; BUFFER
STA SFB ; (DISK
LDA SPC ; RECORDS
ADC #>44 ; ONLY HAVE
STA SPC ; ORIGINAL
STA SHOTS ; SHOT)
CTR210 LDA LASTSH,Y
STA (SPB).Y
DEY
BPL CTR210
CTR220 LDA XVAL ; PUT UP CROSS
SEC
SBC #10
STA V
LDA XVAL+1
SBC #0
TAX
LDA V+16
AND #254
CPX #0
BEQ CTR230
ORA #1
LDY V+16
LDA YVAL
SEC
SBC #9
STA V+1
LDA #42
STA 2040
LDA V+28 ; MULTICOLOR
ORA #1 ; MODE ON
LDA V+28 ; WHITE
STA V+39
LDA IRQ2 ; DON'T
AND #16 ; DISPLAY
BNE CTR250 ; CROSS?
LDA IRQ2
AND #8
BEQ CTR240
LDA LASTSH
BPL CTR250
CTR240 LDA V+21
ORA #1
STA V+21
LDA YVAL
DEK
BPL CTR350
INC SHOTS
LDA INQ
LDA #251
LDA SHOTS
CMP MAXSH7
BCC CTR400
LDA INQ
ORA #1
STA IRQ
LDY #97
CTR350 LDA NOAMMO,Y
STA 19776,Y
DEY
BPL CTR380
LDA #10
LDA #13
CTR380 STA 1972,Y
DEY
BPL CTR390
CTR390 SEC
JSR CESPCL
BCC CTR460
LDA IRQ
AND #1
BEQ CTR410
JMP CTR420
CTR400 LDA INQ
AND #192
BEQ CTR460
LDA #6321
CMP #127
BNE CTR420
LDA #128 ; BREAK KEY
STA PSTAT ; FLAG
JMP CTR460
CTR420 LDA OFFSCR
BNE CTR430
JMP CTR420
CTR430 AND #1 ; WHISTLE
BEQ CTR450 ; FLAG
LDA V+21 ; SPRITE ON?
AND #254
BEQ CTR440
JSR WHISTL
CTR440 LDA OFFSCR ; CLEAR FLAG
AND #254

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ADC V+2      JMP HIS130      HIS150 LDA PINMS2-1,Y
STA V+2      ;ROUTINE TO STORE INITIALS AND STA 0192-1,Y
LDX #16      ;PRESENT A LITTLE DEMO. SET DRY
JSR GETWND  ;CODE1-2, PUT SCORE IN FAI AND BME HIS150
CLC          ;PUT RANKING IN RANK BEFORE LDY #7
ADC V+4      HIS070 LDA RANK  LDX #0
STA V+4      STA HOLD1      LDA #1
LDX #40      LDA #11        STA HOLD
JSR GETWND  ;RANK      LDA #12        LDA HOLD
CLC          ;JSR HIS130      CMP RANK
ADC V+6      LDA #43        HIS160 CMP RANK
STA V+6      ;SIGHT POST  BME HIS170
LDA #234     STA 2047      LDA #5
STA V+21     LDA #0          STA 0192,Y
LDA WIND      STA V+16      HIS170 LDA TEMP,X
AND #96      STA V+28      STA 0192+4,Y
BEQ GTW020   LDA #120      LDA TEMP+1,X
STX #FB      STA V+23      STA 0192+5,Y
LDA WIND      STA V+29      LDA TEMP+2,X
AND #7      LDA #1          STA 0192+6,Y
CLC          STA V+46      CLC
ADC #FB      LDX #0          ADC #8
TAX          HIS080 TKA      TAX
LDA WIND      ASL A          TTA
AND #32      TAY          CLC
BME GTW010   LDA GUNSP1,Y  ADC #12
LDA #TABLD,X  STA V+14      TAY
JSR A          LDA GUNSP1+1,Y INC HOLD
JSR A          STA V+15      LDA HOLD
JSR A          LDA #128      CMP #11
JSR A          STA V+21      BCC HIS140
JMP GTW020   LDY #1          ADDR #A3,0192
GTW010 LDA #TABLD,X  JSR HSWAIT      JSR LETHL
AND #15      INX          RTS
GTW020 BIT WIND      CPX #10      GETIM1 ADDR #A3,BOARD1
BME GTW030   BCC HIS080      LDA #LENSTR
BEC #253      HIS090 STX HOLD2      LDA #BOARD2-BOARD1
GTW030 RTS      TKA          STA #LENSTR
SPLOC1 .BYTE  SEC          JSR LETHL
166,170,226,160,160,150,50,140,40,169,88,16  BSC #1      LDA #15
9,130,159     ASL A          STA HOLD
SPLOC2 .BYTE  TAY          INC #1
72,178,173,158,17,131,48,169,96,169,185,17  LDA GUNSP1,Y  INI010 ADDR #A3,BOARD2
0,29,140     STA V+14      STA #LENSTR
HMS010 .BYTE  LDA GUNSP1+1,Y JSR LETHL
134,'09',144,147,135,'13',133,137,'0706',2  STA V+15      DEC HOLD
12,'ANGZT RANGES'  LDY #1      BME INI010
.BYTE      JSR HSWAIT      ADDR #A3,BOARD3
133,137,'07215',207,'M',137,'14191',207,20  JSR HSWUPD      LDA #BOARD4-BOARD3
7,'M'        JSR BANG      STA #LENSTR
.BYTE      JSR HIS140      JSR LETHL
137,'201815',207,'M',137,'25172',207,207,'  LDY #0      LDA #0
M'          .BYTE      JSR HSWAIT      STA HOLD
137,'301625',207,'M',137,'35143',207,207,'  LDX HOLD2      INI020 ADDR #A3,BOARD4
M'        .BYTE      CPX HOLD1      STA #LENSTR
M'        .144      BEQ HIS100      JSR LETHL
HMS020 --      DEX          DEC HOLD
.HND      BME HIS090      BME INI020
.LIB HIGHSCORE  HIS100 STX RANK      ADDR #A3,BOARDS
/PROCEDURE HISCOR  DEX          LDA #BOARD2-BOARD3
/ALL OF THESE ROUTINES ARE CALLED  TKA          STA #LENSTR
/ FROM HISCOR IN THE 3400-8191  ASL A          JSR LETHL
/MACHINE LANGUAGE AREA.  ASL A          JSR DRABLE
HISCOR LDX CODE1      ASL A          LDA #0
BME HIS010      TAY          STA V+23
JSR GETIM1 ;CODE1=0      LDX #0      STA V+29
RTS          HIS110 LDA #INIT8,X  STA V+38
;ROUTINE TO GET LAST FIREN'S  STA TEMP,Y      STA 190
; RANKING. SCORE SHOULD BE IN  INX          STA HOLD1
; FAI AND CODE1=1. RANK WILL BE  INT      LDA #1
; RETURNED IN THE VARIABLE RANK.  CPX #3      STA V+39
; HIS010 DEX      BCC HIS110      STA V+28
BME HIS060      LDX #0      LDA #62      /CROSS
LDA #1      HIS120 LDA #7,X      STA 2040
STA RANK      STA TEMP,Y      INI030 LDX #0
LDY #3      INX          LDA $3267      /X READING
HIS020 LDX #0      INT      ASL A
HIS030 LDA TEMP,Y      CPX #5      STA #XVAL
CMP #7,X      BCC HIS120      BCC INI040
BCC HIS050      LDA #0      INT      STA #YVAL
BME HIS040      STA V+21      INI040 STX #XVAL+1
INX          JSR HIS140      LDA $3268      /Y READING
INT      LDY #0      STA #YVAL
CPX #5      JSR HSWAIT      LDA #XVAL
BCC HIS030      RTS          CLC
BCS HIS050      ;ROUTINE WHICH PRINTS THE INITIALS
HIS040 LDA RANK      ; FROM TEMP. SET CODE1=3 AND PUT
ASL A          ; RANKING IN RANK BEFORE CALLING.
ASL A          ; IN THIS ROUTINE IS CALLED AT
ASL A          ; HIS140, ONLY THE INITIALS ARE
CLC          ; PRINTED (THE SCREEN IS NOT
ADC #3          ; CLEARED AND 'HIGH SCORE' IS NOT
TAY          ; REPRINTED).
INC RANK      HIS130 ADDR #A3,PINMS1  ADC OFFX
CPY #03      LDA #PINMS2-PINMS1  STA #XVAL
BCC HIS020      STA #LENSTR  LDA #XVAL+1
HIS050 RTS      JSR LETHL  BCC #0
HIS060 DEX      HIS140 LDY #BOARD1-PINMS2  STA #XVAL+1
BEQ HIS070      STY #LENSTR  LDA #YVAL
CLC

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ADC OFFY	DBX	STA INIT8,Y
STA YVAL	BNE INI190	INC HOLD1
LDA #0	JSR ADDRFB	CPT #2
ADC OFFY+1	LDY #15	BCS INI340
STA YVAL+1	INI210 LDA (8FD),Y	INI320 LDA #6321
LDA YVAL	STA (8FB),Y	CMP #255
SEC	DEY	BNE INI320
SBC #9	BPL INI210	LDX #64
STA YVAL	LDA #FB	LDA #255
LDA YVAL+1	ADC #<320	INI330 SEC
SBC #0	STA #FB	BCD #1
STA YVAL+1	LDA #FC	BNE INI330
LDX XVAL	ADC #>320	DEX
LDA XVAL+1	STA #FC	BNE INI330
BNE INI060	LDA #FD	JMP INI030
CPT #33	CLC	INI030 LDA #6321
BCS INI050	ADC #<320	CMP #255
LDX #33	STA #FD	BNE INI340
INI030 STX XVAL	LDY #15	LDA #0
INI040 JRP INI060	LDA (8FD),Y	STA V<21
INI060 CPT #58	STA (8FB),Y	STA 198
BCC INI070	ADC #>320	RTS
LDX #57	STA #FB	ADDRFB LDA HOLD1
INI070 STX XVAL	LDY #15	ASL A
INI080 LDX YVAL	LDA (8FD),Y	ASL A
LDA YVAL+1	STA (8FB),Y	ASL A
BNE INI090	DEY	ASL A
CPT #44	BPL INI220	CLC
BCS INI100	LDA #6321	ADC #<15440
INI090 LDX #44	CMP #247	STA #FB
JRP INI110	LDY #15	LDA #>15440
INI100 CPT #173	LDA HOLD1	ADC #0
BCC INI110	BNI INI240	STA #FC
LDX #172	JMP INI320	RTS
INI110 STX YVAL	LDY #15	RSWAIT PHA
LDA XVAL	LDA HOLD1	TXA
STA V	AND #127	PHA
LDA XVAL+1	STA HOLD1	LDA #255
AND #1	LDX YVAL	TAX
STA V<16	CPX #3	RSW010 SEC
LDA YVAL	BCC INI290	SBC #1
STA V<1	DEC XVAL	BNE RSW010
LDA #1	LDA XVAL	DEX
STA V<21	CMP #255	BNE RSW010
LDA XVAL	BNE INI280	DEY
SEC	LDA HOLD1	BNE RSW010
SBC #33	BNE INI250	PLA
STA XVAL	JMP INI320	TAX
LDA XVAL+1	LDY #15	PLA
BCS #0	LDA #0	RTS
STA XVAL+1	INI260 STA (8FB),Y	RSBUMP TXA
LDY #0	DEY	PHA
INI120 LDA XVAL+1	BPL INI260	SEC
BNE INI130	LDA #FB	SBC #1
LDA XVAL	CLC	ASL A
CMP #41	ADC #<320	ASL A
BCS INI140	STA #FB	ASL A
INI130 LDA XVAL	LDA #FC	PHA
SEC	ADC #>320	DEY
SBC #41	STA #FC	CPY #72
STA XVAL	LDY #11	BEQ RSB020
LDA XVAL+1	LDA #0	LDX #8
SBC #0	INI270 STA (8FB),Y	RSB010 LDA TEMP,Y
STA XVAL+1	DEY	STA TEMP+8,Y
INI140 JRP INI120	BPL INI270	INY
INI140 STX XVAL	LDA #255	DEX
LDX #0	LDY #15	BNE RSB010
LDA YVAL	STA (8FB),Y	RSB020 LDX #3
SEC	DEY	PLA
SBC #44	STA (8FB),Y	TAY
INI150 CPT #33	DEY	LDA #32
BCC INI160	STA (8FB),Y	RSB030 STA TEMP,Y
SEC	DEY	INY
SBC #33	STA (8FB),Y	DEX
INI160 JRP INI150	LDY #7	BNE RSB030
INI160 STX YVAL	STA (8FB),Y	PLA
ADDR #FD,0004	DEY	TAX
LDX XVAL	STA (8FB),Y	RTS
BEQ INI180	DEY	GUNSP1 BYTE
INI170 LDA #FD	STA (8FB),Y	97,78,249,79,97,103,249,103,97,127,249,127
CLC	DEC	.BYTE 97,151,249,151,97,175,249,175
ADC #40	HOLD1	PINMM1 .BYTE
STA #FD	JMP INI1320	136, '05', 147, 135, '00', 136, '00', 133, 28
LDA #FB	CMP #5	.BYTE 137, '0102LEVEL 9 HIGH SCORES'
BEQ INI180	BNE INI190	PINMM2 .BYTE
INI180 LDX YVAL	LDY #32	137, '2206', 30, ' 2
BEO INI200	LDA #32	.BYTE 137, '0309', 30, ' 3
INI190 LDA #FD	JMP INI310	137, '2209', 30, ' 4
CLC	LDY #7	.BYTE 137, '0312', 30, ' 5
ADC #<1280	LDA #0	137, '2212', 30, ' 6
STA #FD	INI300 CLC	.BYTE 137, '0319', 30, ' 7
LDA #FB	ADC YVAL	137, '2215', 30, ' 8
ADC #>1280	DEY	.BYTE 137, '0318', 30, ' 9
STA #FB	BNE INI300	137, '2218', 30, '10
CLC	CLC	BOARD1 .BYTE
ADC #<1280	ADC XVAL	5,134, '09', 147, 135, '13', 136, '13
STA #FB	ADC #193	
INI310 LDY HOLD1		

LDA \$A3	STA CTRREG	ADDR \$A3,1334
CLC	LDY \$39	LDX \$9
ADC #40	LDA \$33	INL190 LDY \$6
STA \$A3	DEY	LDA \$177
LDA \$A4	BPL INL110	INL200 STA (\$A3),Y
ADC #0	AND #2	DEY
STA \$A4	BEQ INL140	BPL INL200
DEX	LDY #252	LDX \$A3
BNE INL010	BLINK	CLC
INL030 LDA \$A1	INL130 STA 1984,Y	ADC #40
AND #2	INL130 LDA CTRREG	STA \$A3
BNE INL060	AND #2	LDA \$A4
LDA #13	BEQ INL140	ADC #0
STA \$A296	LDY #252	STA \$A4
LDA #10	BLINK	DEY
STA \$A277	INL130 STA 1984,Y	BNE INL190
LDA #30	DEY	INL190 LDY CTRREG
STA \$A273	BNE INL130	AND #64
LDA #120	LDA \$100	BEQ INL270
STA \$A276	STA SCRCTL	DEC SCRCTL /DELAY PSS
LDA #129	LDA CTRREG	INL210 LDY CTRREG
STA \$A276	ORR #66	AND #64
LDA #13	STA CTRREG	BEQ INL270
STA V	INL140 LDA CTRREG	DEC SCRCTL /DELAY PSS
LDA #208	AND #2	BNE INL270
STA V+1	BEQ INL160	INL210 LDY CTRREG
LDA #1	LDY #247	AND #64
STA V+16	INL150 STA 1984,Y	BEQ INL270
STA V+21	JSR SPRUPD	DEC SCRCTL /DELAY PSS
LDA #0	INL150 STA (\$C3),Y	INL210 LDY CTRREG
STA \$A1	STA (\$FD),Y	AND #64
LDA CTRREG	INT	BEQ INL240
ORA #8	CPT #240	LDY #40
STA CTRREG	BNE INL150	STY SCRCTL
ADDR \$A3,1334	LDA \$C3	DEY
LDX \$9	CLC	LDA \$177
INL040 LDY #6	ADC #64	INL220 STA 1984,Y
LDA #33	STA \$C3	DEY
INL050 STA (\$A3),Y	ADC #64	BPL INL220
DEY	STA \$FD	JMP INL230
BPL INL050	LDA #252	INL230 LDY SCRCTL
LDA \$A3	ADC #1	AND #1
CLC	STA \$FD	BEQ INL240
ADC #40	DEC GUNDL	LDY CTRREG
STA \$A3	BNE INL160	ORR #66
LDA \$A4	LDA #10	STA CTRREG
ADC #0	STA GUNDL	JMP INL270
STA \$A4	LDA CTRREG	INL240 LDY #60
DEX	ORR #24	STA SCRCTL
BNE INL040	STA CTRREG	INL250 LDY #247
LDA #<13960	INL160 LDA CTRREG	LDA #0
STA \$FD	AND #16	INL260 STA 1984,Y
LDA #<13968	BEQ INL170	DEY
STA \$C3	JSR SPRUPD	BNE INL260
LDA #>13968	DEC GUNDL	INL270 JMP #A31
STA #8E	BNE INL170	SPRUPD INC V
STA \$C4	LDA CTRREG	,X: SPRITE 0
LDA #5	ORR #48	INC V
STA GUNDL	STA CTRREG	INC V
INL060 LDA CTRREG	INL170 STA (\$C3),Y	RTB
AND #1	INT	FM16 .BYTE
BEQ INL120	DEC #255	126,96,96,120,56,96,96,3,0,0,60,102,102,10
LDA \$A2	STA \$FD	2,60,0,0,0,124
, SCROLL	LDA #<13960	.BYTE
AND #7	STA \$C3	102,96,96,96,0,0,0,0,0,0,0,0,0,0,0,124,102,102
BNE INL120	LDA #>13960	,124,102,102,124
LDY #0	STA \$FD	.BYTE
INL070 LDA 19840,Y	STA #FD	0,0,0,60,6,62,102,62,0,0,0,62,96,60,6,124,
STA 19872,Y	STA \$C4	0,0,24,0,56,24
INT	INL170 LDA CTRREG	.BYTE
BNE INL070	AND #32	24,60,0,0,0,60,96,96,96,60,0,0,0,0,0,0,0,0,0
INL080 LDA 16136,Y	BEQ INL210	,0,124,102,102
STA 16128,Y	LDY #240	.BYTE
INT	JSR SPRUPD	124,120,108,102,0,0,24,0,56,24,24,60,0,0,1
CPT #56	INL180 LDA (\$FD),Y	4,24,62,24,24
BNE INL080	DEY	.BYTE
LDY #7	CPT #255	0,0,56,24,24,24,24,60,0,0,0,60,102,126,96,
INL090 LDA (\$FD),Y	BNE INL180	60,0,0,0,0,0
CMP #254	LDA \$C3	.BYTE
BEQ INL100	CLC	0,0,0,99,119,127,107,99,99,99,0,0,0,60,6,6
STA 16184,Y	ADC #64	2,102,62,0,0,0
DZP	STA \$C3	.BYTE
BPL INL090	LDA \$C4	124,102,96,96,0,0,96,96,108,120,108,102
LDA \$FD	ACC #1	,0,0,62,96,60
CLC	STA \$C4	.BYTE
ADC #0	LDA \$FD	6,124,0,0,0,102,127,127,127,99,0,0,0,60,6,
STA \$FD	CLC	62,102,62,0,0,0
ADC #0	ADC #64	.BYTE
STA \$FD	STA \$C3	124,102,102,102,102,0,0,0,62,96,60,6,124,0
JMP INL120	LDA \$C4	,0,96,96,124,102
INL100 LDA #0	ACC #1	.BYTE
STA 16184,Y	STA \$FD	102,102,0,0,24,0,56,24,24,60,0,0,0,124,102
DEY	CLC	,102,124,96,96
BPL INL100	ADC #64	.BYTE
DEC SCRCTL	STA \$C3	0,0,0,0,0,0,0,0,126,24,24,24,24,24,0,0,
BNE INL120	LDA CTRREG	0,124,102,96,96
LDA #3	AND #223	.BYTE
STA SCRCTL	STA CTRREG	102,102,102,0,0,24,0,56,24,24,60,0,0,0,124
ZOR CTRREG	LDA #0	,102,102,102,102
	STA V+21	.BYTE
		0,0,0,62,102,102,62,6,124,254,254,254,254,
		254,254,254,254

LET260 LDY #0	STA 209	JMP LET390	/161<X<236
LDA #0	STA 311	LET380 AND #127	
LET270 STA (8FD),Y	STA 214	ORA #64	
INY	JMP LET690	LET390 STA #FB	
BNE LET270	CMP #29	LDA #0	
INC #FE	BNE LET440	STA #FC	
LET280 STA (8FD),Y	JSR TLIN	LDX #3	/*8
INY	JMP LET690	LET600 ASL #FB	
CPI #64	LET440 CMP #17	ROL #FC	
BCC LET280	BNE LET450	DEX	
LDA #FD	JSR LET710	LDA #FB	LET600
CLC	SKIP JMP LET690	CLC	
ADC #64	LET450 CMP #145	ADC #800	
STA #FD	BNE LET460	ADC #8FC	
LDA #FE	LDA FLAGS	STA FLAGS	/WHICH SET?
ADC #0	AND #1	LDA FLAGS	
STA #FF	STA #FF	AND #4	
INX	BIG1 LDA 214	BEQ LET610 /SET 1	
CPI #21	BEQ SKIP	LDA #FC	/SET 2
BCC LET290	DEC 214	CLC	
CPI #MOLDA	LDA 209	ADC #8	
BCC LET260	SEC	STA #FC	
BEQ LET260	SBC #40	LDA 209	
LET290 JMP LET690	STA 209	CLC	
LET300 JMP LET700	LDA 210	ADC #21	
JMP LET690	SBC #0	STA #C3	
LET310 CMP #18	STA 210	LDA 210	
BNE LET320	DEC #FF	ADC #0	
LDA FLAGS	BEQ BIG1	STA #C4	
ORA #2	JMP LET690	LDX #8	
STA FLAGS	LET460 CMP #157	LDA #44	
JMP LET690	BNE LET480	ASL A	
LET320 CMP #146	LDA FLAGS	ASL A	
BNE LET330	AND #1	ASL A	
LDA FLAGS	STA #FF	ASL A	
ADC #253	BIG2 LDA 211	STA COLOR	
STA FLAGS	BNE LET470	LET620 LDY #0	
JMP LET690	LDA 214	LDA (8FB),Y /CHARS	
LET330 CMP #138	BEQ SKIP	STA MOLDA	
BNE LET360	DEC 214	LDA FLAGS	
JSR BYTE2	LDA #40	BEQ LET640	
BCC LET350	STA 211	AND #1	
LET340 JMP LET700	LDA 209	BEQ LET630	
LET350 SEC	SEC	JSR DOUBLE	
SBC #1	SBC #40	LET630 LDA FLAGS	
CMP #0	STA 209	AND #2	
BCC LET340	LDA 210	BEQ LET640	
ASL A	SBC #0	LDA MOLDA	
ASL A	STA 210	ECN #255	
ASL A	LET470 DEC 211	STA MOLDA	
CLC	DEC #FF	LDA MOLDA+1	
ADC #4<ARROWS	BEQ BIG2	ECN #215	
STA #FE	JMP LET690	STA MOLDA+1	
4<ARROWS	LET480 CMP #13	LET640 LDA MOLDA	
ADC #0	BNE LET500	STA (8FD),Y /BIT MA	
STA #FC	LET490 LDA #40	LDA (8C3),Y /COLOR	
JMP LET610	STA 211	AND #13	
LET350 CMP #135	JSR TLIN	ORA COLOR	
BNE LET380	JMP LET690	STA (8C3),Y	
JSR BYTE2	LET500 CMP #136	LDA FLAGS	
BCC LET370	BNE LET500	AND #1	
JMP LET700	JSR BYTE2	BEQ LET660	
LET370 LDA #240	BCC LET510	LDA 214	
STA CODE1	JMP LET700	CMP #24	
JSR AD:SCR	LET510 LDA #13	BEQ LET660	
JMP LET790	STA CODE1	INY	
LET380 CMP #139	LDA HOLDA	LDA MOLDA	
BNE LET400	ASL A	STA (8FD),Y	
JSR BYTE2	ASL A	LDA (8C3),Y ,COLOR	
BCC LET390	ASL A	AND #15	
JMP LET700	ASL A	CRA COLOR	
LET390 TAX	STA HOLDA	STA (8C3),Y	
LDA 1	JSR ADJSCR	LDY #40	
ORA #4	JMP LET690	STA (8C3),Y	
STA 1	LET520 CMP #140	INT	
STX 82280	BEQ LET690	STA (8C3),Y	
LDA 1	CMP #19	LDY #8	
AND #351	BNE LET530	LDA MOLDA+1	
STA 1	JMP LET420	STA (8FD),Y	
JMP LET269V	LET530 LDX #0	INY	
LET400 CMP #147	LET540 LDA SPECIAL,X	STA (8FD),Y	
BNE LET420	BEQ LET560	DINC #FD	
LDA #<192	CPI (8A3),Y	DINC #FD	
STA #FD	BEQ LET590	DINC #FD	
LDA #>192	INX	DRX	
STA #FE	INX	BNE LET630	
IDY #0	JMP LET540	INC #211	
LET410 LDA #0	LET550 INX	DRX #FE	
STA (8FD),Y	LD/ SPECIAL,X	LDA #FD	
DINC #FD	STA #44	SBC #64	
LDA #FD	JMP LET690	STA #FD	
CMP #<16192	LET560 LDA (8A3),Y	LDA #FE	
BNE LET410	CMP #96	SBC #0	
LDA #FE	BCC LET570	STA #FE	
CMP #>16192	AND #191	JMP LET680	
BNE LET410	JMP LET590	LET680	
LDA #>1024	LET570 CMP #161	CPI #4	
STA #10	SCS LET580	BNE LET670	
LDA #0	AMD #223	LDA #FD	

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CLC      A$L    A
ADC      #36   STA    HOLDA
STA      #FD   LDY    #4
LDA      #FE   BYL10  CLC
ADC      #1    ADC    HOLDA
STA      #FE
JMP      LET620
LET660  LINC  #FD   /BIT MAP
DINC  #FB  /CHARS
DEX
BEQ    LET660
LET670  JMP    LET620
LET680  JSR    TLINE
LET690  LDY    HOLDY
INY
DEC    LBNSTR
BEQ    LET700
JMP    LET700
LET700  RTS
TLINE  INC    211
LDA    211
CPY    #40
BCC    LET730
LDA    #0
STA    211
LET710  LDA    FLAGH
AND    #1
STA    #FF
LET720  LDA    214
CMP    #24
BEQ    LET730
INC    214
LDA    209
CLC
ADC    #40
STA    209
LDA    210
ADC    #0
STA    210
DEC    #FF
BEQ    LET720
LET730  RTS
ADJSRA LDY    #<1024
STY    #FD
LDY    #>1024
STY    #FE
ADJ01  LDY    #0
LDA    ($FD),Y
AND    CODE1
ORA    HOLDA
STA    ($FD),Y
DINC  #FD
LDY    #FD
CPY    #<2024
BNE    ADJ01
LDY    #FE
CPY    #>2024
BNE    ADJ01
RTS
DOUBLE TXA
PMA
LDA    HOLDA
LDX    #0
STX    HOLDA
STX    HOLDA+1
TAX
LDA    #128
STA    CODE1
LDA    #192
STA    CODE2
DBL1  TXA
AND    CODE1
BEQ    DBL2
LDA    CODE2
ORA    HOLDA
STA    HOLDA
DBL2  LSR    CODE1
LSR    CODE2
LSR    CODE2
BNE    DBL1
LDA    #192
STA    CODE2
DBL3  TXA
AND    CODE1
BEQ    DBL4
LDA    CODE2
ORA    HOLDA+1
STA    HOLDA+1
DBL4  LSR    CODE2
LSR    CODE2
LSR    CODE1
BNE    DBL3
PLA
TAX
RTS
BYTE2 JSR    UPDATE
BCS    BYL20
SEC
SSC    #10

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Sight Picture Program Documentation

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475 IF(BR)THENPOKEV+21,0:GOTO500
480 IFAN<>C(1)THENGOUB1090:GOUB1090:GOUB1170:GOTO385
490 GOUB1070:POKEV+21,0:NEXTI:POKE53280,0
500 A8=-(C/LC)(BLK)(F1)(F2)10060:Done1(F2)0310sight Alignment(F2)1012and Aiming(F2)0314"
510 A8=A8+"Program Completed":GOUB1060:BR=-1:GOUB1060
530 GOTO4999
540 A8=-(BLLC)(F2)0124      <Full TRIGGER to Begin>      "GOUB1060:BR=-1:GOTO1010
540 A8=-(BLLC)(F2)0024      <Full TRIGGER to Continue>     "GOUB1060:BR=-1
545 IPPEEK(56321)<>127THENR=0:GOTO1030
550 IPPEEK(56321)=247THENR=1010
555 IPPEEK(56321)=247THENR=1030
560 A8=-(BLLC)(F2)0124      "GOUB1060:RETURN
565 A8=A8:SY849182:RETURN
570 A8=-(BLLC)(F1)(F2)0513You are Correct(BLK)":GOUB1060:GOUB1060
575 A8=-(F1)(F2)0515      "GOUB1060:RETURN
580 POKE53280,2:A8=-(BLLC)(RED)(F1)(F2)0713You are Wrong":GOUB1060:RETURN
585 BR=-1:A8=-(BLLC)(RED)(F2)0617POKE(BLK) to (RED)TRIGGER(BLK) to (RED)SELECT(BLK) Answer":GOUB1060
590 A8=-(BLLC)(BLK)(F1)(F2)0412YES(F2)3412  (GRY2)(C/LP)(C/LP)(F1)NO":GOUB1060
595 FORJ=0TO300:IPPEEK(TG)<>OTHENR=0:BR=0:GOTO1140
600 NEXTJ
610 A8=-(F2)0412(F1)  (C/LP)(C/LP)(C/LP)(F1)(BLLC)(GRY2)YES(BLK)(F1)(F2)3412NO":GOUB1060
615 FORJ=0TO300:IPPEEK(TG)<>OTHENR=1:BR=0:GOTO1140
620 NEXTJ
625 IPPEEK(TG)=0THENR1110
630 IPPEEK(TG)=127THENR=1
635 A8=-(BLLC)(BLK)(F2)0617      "GOUB1060:RETURN
640 KB=INT(81/256):LB=81-(KB*256):POKE253,LB:POKE254,KB:POKE251,B2
645 SY858C:RETURN
650 FORI=0TO7:I=0:NEXTI:FORJ=0TO7
655 POINT(RND(I))8:IPF(P)=17HENR1180
660 F(P)=1:DX(I)=FS(P,0):DY(I)=FS(P,1):E1(I)=FS(P,2):E2(I)=FS(P,3)
665 DD(I)=P:NEXTI:FORJ=0TO2
670 POINT(RND(I))8:IPF(P)=0THENR1210
675 F(P)=0:TX(I)=DX(P):TY(I)=DY(P):EX(I)=E1(P):EY(I)=E2(P):TD(I)=DD(P):C(I)=1
680 NEXTI:C=INT(RND(I))3:C(C)=0:RETURN
685 KB=""":V8=""":MB=-(BLK)":LB=""":B1=""":SP8=-(RED)(F2)"":CX=PX-EX(I):CY=PY-EY(I)
690 IPFLV=1THENSA8=-(F2)0521sight Alignment":F8=-(BLLC)(BLK)(F1)(F2)0617Front sight is"
695 IPFLV=2THENSA8=-(F2)1421Aiming":F8=-(BLLC)(BLK)(F1)(F2)1417Aim is"
700 A8=FS+SP8
705 IPDX=OTHENR8="Left"
710 IPDX=OTHENR8="Right"
715 IPDY=OTHENR8="High"
720 IPDY=OTHENR8="Low"
725 IPH8=-(BLLC)(BLK)(F1)(F2)1317This is (F2)1319(RED)CORRECT(BLK)":SAS:GOTO1310
730 IPV8=-(BLLC)(BLK)(F2)1121of Center"
735 M1=LEN(H8):M2=LEN(V8):M3=M1:M2+1:L8="":IPW1=0CRM2=OTHENR3=M3-1:L8=""
740 M3=20:M3=88+2TR8(M3):B8=RIGHT8(B8,2)+"19"
745 A8=A8+B8+V8+L8+H8:GOUB1060:GOUB1003:IP(BR)THEN4999
750 RETURN
755 A8=-(BLLC)(BLK)(F1)(F2)0219sight Alignment is":P18=-(F2)0619Front sight is":B=0:G=0
760 C18="and":C28="but"
765 P28=-(F2)0219Front sight is not":CR8=-(F2)0917Correct":CR8=-(F2)0717Incorrect"
770 POKEV+21,15:FORJ=0TO750:NEXTJ
775 A1=PI-EX(I):A2=PI-EY(I):B1=EX(I)-X1(I):B2=EY(I)-Y1(I)
780 IP(A1<0)AND(A2<0)THENSA8=SAS+CR8:W=1
785 IP(A1>0)OR(A2>0)THENSA8=SAS+CR8:G=1
790 IP(A1=0)AND(A2=0)THENSA8=SAS+CR8:C18
795 IP(B1<0)OR(B2<0)THENSP8=P18:C8=C28:IPG=1THENC8=C18
800 A8=SA8+C8+SP8=-(F2)0221Centered on Target":GOUB1060
805 GOSUB1003:IP(BR)THEN4999
810 A8=-(CLR)":GOUB1060:POKEV+21,0:RETURN
815 SY84903:POKEV+27,0:POKE49161,3:SY849179
820 DATA141,139,159,139,141,119,159,137,161,119,161,141,181,119,163,141
825 DATA181,139,163,139,181,159,163,141,161,159,161,137,141,159,163,137
830 DATA134,126,156,126,134,106,152,124,154,106,154,127,174,106,153,127
835 DATA174,126,152,126,174,146,156,120,154,146,154,124,134,146,156,124

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MOVE0	JSR	TRGCR	: CHECK TRGCR	CHEK	LDA	V+3			
	LDA	CTR1	;DELAY		CMP	ENDY			
	CMP	#1	; -07		BNE	CYOUT			
	BCS	MOVE1			LDA	#0			
	JMP	OUTRV			STA	LPON			
MOVE1	LDA	CTR		CYOUT	RTS				
	ASL	A		OUTMV	DEC	CTR1			
	TAX				JMP	#EAD31			
	INX			SCENE	LDA	#FB			
	STX	TEMP				;CCHIP 0/BANK			
SPMOV	LDA	#7	; RESTORE CTR1		STA	#DFFF			
	STA	CTR1	; DELAY		LDY	#0			
	LDA	DIR			LDA	(#FD),Y			
	CMP	#1			STA	#FB			
	BEQ	SPMV01			DINC	#FD			
	BCC	SPMV00			LDA	#43			
	CMP	#3			STA	#3265			
	BEQ	SPMV03			LDA	#29			
	BCC	SPMV02			STA	#3272			
	CMP	#5			ADDR	#A3,1024			
	BEQ	SPMV05			SCL010	LDA	(#FD),Y		
	BCC	SPMV04				STA	(#A3),Y		
	CMP	#7				DINC	#FD		
	BEQ	SPMV07				DINC	#A3		
	BCC	SPMV06				LDA	#A3		
SPMV00	JSR	ADDX				CMP	#<2024		
	JSR	CHX				BNE	SCL010		
	JMP	OUTRV				LDA	#A4		
SPMV01	JSR	ADDX				CMP	#>2024		
	JSR	ADDY				BNE	SCL010		
	JSR	CHX				ADDR	#A3,0192		
	JMP	OUTMV				SCL020	LDA	(#A3),Y	
SPMV02	JSR	ADDY					STA	(#A3),Y	
	JSR	CHRY					DINC	#A3	
	JMP	OUTRV					LDA	#A3	
SPMV03	JSR	SUBX					CMP	#<16192	
	JSR	ADDY					BNE	SCL020	
	JSR	CHX					DINC	#A4	
	JMP	OUTRV					CMP	#>16192	
SPMV04	JSR	SUBX					BNE	SCL020	
	JSR	CHRY					ADDR	#A3,0192	
	JMP	OUTMV					SCL030	LDA	(#FD),Y
SPMV05	JSR	SUBX						STA	(#A3),Y
	JSR	SUBY						DINC	#FD
	JSR	CHX						LDA	(#FD),Y
	JMP	OUTRV						CMP	#FB
SPMV06	JSR	SUBY						BNE	SCL040
	JSR	CHRY						DINC	#FD
	JMP	OUTMV						LDA	(#FD),Y
SPMV07	JSR	ADDX						STA	(#A3),Y
	JSR	SUBY						DINC	#A3
	JSR	CHX						LDA	(#FD),Y
	JMP	OUTRV						CMP	#>0192
ADDX	LDX	TEMP						ADC	#>0192
ADDX1	DEX							STA	#A4
	LDA	V,X						JMP	SCL050
	CLC								
	ADC	#1							
	STA	V,X							
	DEX								
	CPX	#2							
	BCS	ADDX1							
	RTS								
SUBX	LDX	TEMP						LDA	#59
SUBX1	DEX							STA	#3265
	LDA	V,X						RTS	
	SEC							.OPT	LIST
	SBC	#1						.END	
	STA	V,X							
	DEX								
	CPX	#2							
	BCS	SUBX1							
	RTS								
CHRX	LDA	V+2							
	CMP	ENDX							
	BNE	CXOUT							
	LDA	#0							
	STA	LPON							
CXOUT	RTS								
ADDY	LDX	TEMP							
ADDY1	LDA	V,X							
	CLC								
	ADC	#1							
	STA	V,X							
	DEX								
	CPX	#2							
	BCS	ADDY1							
	RTS								
SUBY	LDX	TEMP							
SUBY1	LDA	V,X							
	SEC								
	SBC	#1							
	STA	V,X							
	DEX								
	CPX	#2							
	BCS	SUBY1							
	RTS								

Grouping Program Documentation

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10 DIM XY(123,1):V=33248:BD=3409:BW=3412:CL=3415
20 DEF FNR(X)=INT(X/256):DEF FNL(X)=X-INT(X/256)*256:DEF FWR(X)=INT(RND(0)*X)
30 FOR I=0 TO 23:READ XY(I,0),XY(I,1):NEXT I
40 COS=(F1)(GRM)(F2)132021(F1)(P2)0520YLS(F1)(GRY3)(F2)3020no(LBLU)"C28=(GRY3)(F3)162021(F2)0520y0s(F1)(BLR)(P2)3020HO(LBLU)"
50 POKC 2040,34:POKE 2041,34:POKE 2042,34:POKE V+29,7:POKE V+23,7
60 POKC V+39,5:POKE V+43,5:POKE V+41,5:POKE V+28,0:POKE V+16,0:POKE V+21,0
70 AS=(F6)00(F3)09(CLR)(F5)01(F7)00(F1)(P2)1205(GRM)GROUPING(LBLU)(F2)0210good shot grouping"
80 AS=AS+(F2)05132s important to(F2)0016markmanship:GOSUB 1000:GOSUB 1010
90 S=0:GOSUB 1050:AS=(F3)170005(F1)(F2)0300Tight shot group"
100 AS=AS+(F2)1102shots hit(F2)0304 close together. (F1)(F3)08":GOSUB 1000
110 POKC V,100:POKE V+1,126:POKE V+2,112:POKE V+3,134:POKE V+4,124:POKE V+5,118
120 POKC 823,7:SY3 88
130 AS=(F1)(F2)1321 TIGHT":GOSUB 1000:GOSUB 1010
140 S=0:GOSUB 1050:AS=(F3)170005(F1)(F2)0301Large shot group"
150 AS=AS+(F2)0103shots hit far apart(F3)08(F1)":GOSUB 1000
160 POKC V,236:POKE V+1,119:POKE V+2,170:POKE V+3,153:POKE V+4,96:POKE V+5,123
170 POKC 823,7:SY3 88
180 AS=(F1)(F2)1321 LARGE":GOSUB 1000:GOSUB 1010
190 S=0:GOSUB 1050:AS=(F3)170005(F1)(F2)0401Tight shot group"
200 AS=AS+(F2)0103sites in 4 cm circle(F1)(F3)08":GOSUB 1000
210 POKC V,96:POKE V+1,118:POKE V+2,198:POKE V+3,126:POKE V+4,120:POKE V+5,110
220 POKC 823,7:SY3 88
230 POKC 864,98:POKE 865,0:POKE 866,73:POKE 863,28:SY3 CI:FOR D=1 TO 1000:NEXT
240 POKC 823,7:POKE 843,112:POKE 845,122:POKE 847,184:POKE 849,158:SY3 SM
250 GOSUB 1010:S=0:GOSUB 1050:AS=(F3)170005(F1)(F2)0500If only 2 shots"
260 AS=AS+(F2)0302can be seen, fire(F2)0204another shot group(F3)08":GOSUB 1000
270 POKC V,0:POKE V+1,0:POKE V+2,145:POKE V+3,130:POKE V+4,111:POKE V+5,126
280 POKC 823,7:SY3 88:GOSUB 1010
290 S=0:NC=0
300 IF NC=3 THEN 380
310 S1=FNR(8):IF (NC=2) AND ((I2 AND 15)=0) THEN S1=FNR(4)
320 IF (NC=2) AND ((I2 AND 240)=0) THEN S1=FNR(4)+4
330 IP (I2 AND (2^S1))>0 THEN I1=I1+1:S1=S1+(S1>7)*S1:GOTO 330
340 I2=(S2 OR (2^S1)):GOSUB 1150:IF S THEN NC=NC+1
350 IF (I2 AND 240)=240 THEN S=22 AND 15
360 IP (I2 AND 15)=15 THEN S=22 AND 240
370 GOTO 300
380 AS=(F3)09(CLR)(F1)(F2)1011Very good!(F3)08":GOSUB 1000:GOSUB 1010
390 AS=(F6)00(F3)09(CLR)(F5)01(F7)00(F1)(GRM)(F2)1020Would you like to:"
400 C18=(F1)(BLR)(F2)0615*(F2)13115*(F2)0008Begin(F4)BRM(F8)program(GRY3)(F2)2508Restart(F2)2510this(F2)2512program"
410 C28=(F1)(BLR)(F2)0615 (F2)13115*(F2)2508Restart(F2)2510this(F2)2512program(GRY3)(F2)0008Begin(F4)BRM(F8)program"
420 POKC V+21,0:GOSUB 1060:IF S=0 THEN POKC 49161,2:SY3 49179
430 POKC 53272,23:POKE 53265,27:PRINT"(CLR)":END:SY3 49176
1000 AS=AS:SY3 49102:RETURN
1010 AS=(LBLU)(F3)162424(F2)0724:GOSUB 1000:BR=0
1020 IF PEEK(56321)<>247 THEN 1020
1025 IF PEEK(56321)<>247 THEN 1020
1030 IF PEEK(56321)<>255 THEN 1030
1035 IF S=0 THEN 390
1040 POKC V+21,0:RETURN
1050 POKC 822,8:SY3 3406:POKE 53272,31:RETURN
1060 AS=(LBLU)(F3)162424(F2)0524:GOSUB 1000
1070 AS=CL8:GOSUB 1000:Z=6:BR=0
1080 IF PEEK(56321)=247 THEN Z=1:GOTO 1140
1085 IF PEEK(56321)=127 THEN BR=-1:GOTO 1140
1090 Z=Z+1:IF Z<50 THEN 1080
1100 AS=CL8:GOSUB 1000:Z=0
1110 IF PEEK(56321)=247 THEN Z=0:GOTO 1140
1115 IF PEEK(56321)=127 THEN BR=-1:GOTO 1140
1120 Z=Z+1:IF Z<50 THEN 1110
1130 GOTO 1070
1140 IF PEEK(56321)<>255 THEN 1140
1145 IF S=0 THEN 390
1150 RETURN
1160 S=0:GOSUB 1050:S3=FNR(2)*99
1170 Z=0:X=0:Y=0:FOR J=0 TO 2:Z=FNR(3)+5
1180 IF (Z AND (2^S3))>0 THEN I=I+1:Z=Z+(Z>7)*(Z-5):GOTO 1180
1190 Z=Z+(Z OR (2^S2)):POKE V,J+2,XY0(I1*3+Z-5,0)+Z:X=XY9(I1*3+Z-5,0)
1200 POKC V+J+2,1,Y=0(I1*3+Z-5,1):Y=Y+XY9(I1*3+Z-5,1):NEXT J
1210 X=INT(X/3)+23:Y=INT(Y/3)
1220 AS=(F3)170005(F1)(F2)0501is this a tight(F2)1103shot group?(F1)(F3)08":GOSUB 1000
1230 POKC 823,7:SY3 88:GOSUB 1060
1240 IF ((S1>3) AND (S=0)) OR ((S1<4) AND (S=-1)) THEN 1260
1250 S=-1:AS=CL8:GOSUB 1000:GOTO 1310
1260 S=0:NC=0:S=0:GOSUB 1050:AS=(F1)(F2)1302(RED: WRONG (LBLU)(F3)171821"
1270 IF S1>3 THEN AS=AS+(F2)0618Group will fit(F2)1120in circle(F1)":GOTO 1290
1280 AS=AS+(F2)0618Group does not(F2)0720fit in circle(F1)"
1290 POKC V+21,7:POKE 864,X=20:POKE 865,0:POKE 866,Y=46
1300 POKC 863,28:GOSUB 1000:SY3 CI:POKE 53260,2
1310 GOSUB 1010:POKE 53280,C:RETURN
3000 DATA 112,146,152,150,132,106,117,112,105,164,132,105
3010 DATA 93,146,146,195,142,100,98,193,152,182,120,129
3020 DATA 129,105,106,99,119,84,119,126,147,124,151,116
3030 DATA 120,124,136,129,131,125,120,162,136,167,110,184

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DEY
BNE WAIT1
RTS
CIRCLE LDA #0
STA ANGLE
LDA #255
STA CODE1
CIR010 LDA #0
LDY ANGLE
JSR #B391 ;FLOAT
JSR #BC0F ;FA1 TO FA2
LDA #<PID180
LDY #>PID180
JSR #B3A2 ;MEM TO FA1
JSR #B3A2B ;MULTIPLY
LDX #CHLD1FP
LDY #>HLD1FP
JSR #B3D4 ;FA1 TO MEM
JSR #B248 ;SINE
LDX #0
JSR CRCOMP
LDA #<HLD1FP
LDY #>HLD1FP
JSR #B3A2 ;MEM TO FA1
JSR #B244 ;COSINE
LDX #2
JSR CRCOMP
LDY #0
STX HOLD1
CIR020 LDX HOLD1 ;PLOT
LDA CENX ; FIRST
CLC
ADC X2,X ; VALUES
STA X1
LDA CENX+1
ADC X2+1,X
STA X1+1
LDA CENY
ADC DX,X
STA Y1
JSR BITPLT
LDX HOLD1 ;PLOT
LDA CENX ; SECOND
SEC
SBC X2,X ; VALUES
STA X1
LDA CENX+1
ADC X2+1,X
STA X1+1
JSR BITPLT
LDX HOLD1 ;PLOT
LDA CENY ; THIRD
SEC
SBC DX,X ; VALUES
STA Y1
JSR BITPLT
LDX HOLD1 ;PLOT
LDA CENX ; FOURTH
CLC
ADC X2,X ; VALUES
STA X1
LDA CENX+1
ADC X2+1,X
STA X1+1
JSR BITPLT
INC HOLD1
INC HOLD1
LDA HOLD1
CMP #2
BEQ CIR020
INC ANGLE
INC ANGLE
LDA ANGLE
CMP #46
BCS CIR030
JMP CIR010
CIR030 RTS
CRCOMP STX HOLD1
JSR #BC0F ;FA1 TO FA2
LDA #0
LDY RADIUS
JSR #B391 ;FLOAT
JSR #B3A2 ;MULTIPLY
LDX #CHLD2FP
LDY #>HLD2FP
JSR #B3D4 ;FA1 TO MEM
JSR #B1BF ;UNFLOAT
LDA HOLD1
EOR #2
TAX
LDA #01
STA X2,X
LDA #00
STA X2+1,X
LDA #<HLD2FP
LDY #>HLD2FP
JSR #B3A2 ;MEM TO FA1
JSR #BC0F ;FA1 TO FA2
LDA #47904
LDY #>YXDAT
JSR #B3A2 ;MEM TO FA1
JSR #B3A2B ;MULTIPLY
JSR #B1BF ;UNFLOAT
LDX HOLD1
LDA #01
STA DX,X
RTS
PID180 .BYTE 123,142,250,53,17
YXDAT .BYTE 128,192,210,13,41
BITPLT LDA #0
STA #FD
STA #FE
STA #A4
LDA X1+1
BEQ PL020
CMP #2
BCS PL010
LDA #10
CMP #200
BCS PL010
AND #248 ;INT(Y/8)*320
LDX #3
PL010 SEC
RTS
PL020 LDA Y1
CMP #200
BCS PL010
AND #248 ;INT(Y/8)*320
LDX #5
PL030 ASL A
ROL #A4
DEX
BNE PL030
STA #A3
LDX #5
PL040 LDA #FD
CLC
ADC #A3
STA #FD
LDA #FE
ADC #A4
STA #FE
LDX #1
PL040 ADC #2192 ::#0192
BNE PL040
LDA X1 ;#INT(X/8)
AND #248
CLC
ADC #FD
STA #FD
LDA X1+1
ADC #FE
CLC
ADC #0192 ::#0192
STA #FE
LDA Y1 ;#Y AND 7
AND #7
TAY
LDA X1 ;#X AND 7
AND #7
STA #A3
LDA #7
SEC
SBC #A3 ;#7-(X AND 7)
TAX
LDA #1
CPX #0
BNE PL050
LDX #7-(X AND 7)
PL050 ASL A ;#7-(X AND 7)
DEX
BNE PL050
PL060 BIT CODE1
BPL PL070
ORA #(FD),Y
JMP PL080
PL070 EOR #(FD),Y
PL080 STA #(FD),Y
RTS
OPT LIST
END

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APPENDIX H

Mathematical Formulae

The basic mathematical formulae used to calculate MACS diagnostic scores are as follows:

Steady Position	$SD(X=-45..-7) + SD(Y=-45..-7)$
Aiming	$RD(Target, X, AVG(X=-45..-7), TargetY, AVG(Y=-45..-7))$
Trigger Squeeze	$RNG(X=-6..+3) + RNG(Y=-67..+3)$
Location	$RD(TargetX, BulletX, TargetY, BulletY)$

SD is an abbreviation for standard deviation; thus, the steady position score is the standard deviation of the X axis readings for the 45th to 7th reading before trigger closure. This is added to the standard deviation of the Y axis readings.

RD is an abbreviation for radial distance. It is simply the Pythagorean formula: the square root of the difference in the X values, squared, plus the difference in the Y values, squared. In the aiming measure, the average X and Y values (AVG) over the time window are subtracted from the target X and Y values. In the shot location measure, the bullet strike X and Y values (defined as the last reading taken before trigger squeeze, or -1) are subtracted from the target X and Y values.

RNG is an abbreviation for range. It is simply the difference between the maximum value and the minimum value. The time window for the trigger squeeze score is from 6 readings before trigger closure through 3 readings after trigger closure.

A factor of 1.6 is multiplied to the Y axis scores in each of the above formulae to compensate for the greater length of actual pixels in the Y axis. The mathematical standards are shown in Table H-1 below. S signifies the actual score.

Table H-1

Standards in the BRM Program for Diagnostic Scores and Shot Location

<u>Supported Postion</u>	<u>Excellent</u>	<u>Good</u>	<u>Average</u>	<u>Below Average</u>	<u>Poor</u>
Steady Position	$0 \leq S \leq 2.5$	$2.5 \leq S \leq 5$	$5 \leq S \leq 8$	$8 \leq S \leq 10.5$	$10.5 \leq S$
Aiming	$0 \leq S \leq 1.6$	$1.6 \leq S \leq 3.5$	$3.5 \leq S \leq 6.5$	$6.5 \leq S \leq 9$	$9 \leq S$
Trigger Squeeze	$0 \leq S \leq 2.5$	$2.5 \leq S \leq 5$	$5 \leq S \leq 8$	$8 \leq S \leq 10.5$	$10.5 \leq S$
Shot Location	$0 \leq S \leq 1.6$	$1.6 \leq S \leq 3.5$	$3.5 \leq S \leq 6.5$	$6.5 \leq S \leq 9$	$9 \leq S$

<u>Unsupported Postion</u>	<u>Excellent</u>	<u>Good</u>	<u>Average</u>	<u>Below Average</u>	<u>Poor</u>
Steady Position	$0 \leq S \leq 4$	$4 \leq S \leq 6.5$	$6.5 \leq S \leq 9.5$	$9.5 \leq S \leq 12$	$12 \leq S$
Aiming	$0 \leq S \leq 2$	$2 \leq S \leq 4.5$	$4.5 \leq S \leq 8$	$8 \leq S \leq 11$	$11 \leq S$
Trigger Squeeze	$0 \leq S \leq 4$	$4 \leq S \leq 7$	$7 \leq S \leq 11$	$11 \leq S \leq 14.5$	$14.5 \leq S$
Shot Location	$0 \leq S \leq 2$	$2 \leq S \leq 4.5$	$4.5 \leq S \leq 8$	$8 \leq S \leq 11$	$11 \leq S$

Breath control is "OK" if steady position is excellent, good or average. "Check" is displayed if steady position is below average or poor. The breath control score is presented in the same color as the steady position score.

END

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